MEASURING MULTIVARIATE RISK PREFERENCES

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We measure risk preferences for decisions that involve more than a single, monetary attribute. According to theory, *correlation aversion*, *cross-prudence* and *cross-temperance* determine how risk preferences over two single attributes co-vary and interact. We obtain model-free measurements of these cross-risk attitudes in three economic domains, *viz.*, time preferences, social preferences, and preferences over waiting time. This first systematic empirical exploration of multivariate risk preferences provides evidence for assumptions made in economic models on inequality, labor, time preferences, saving, and insurance. We observe non-neutrality of cross-risk attitudes in all domains which questions the descriptive accuracy of economic models that assume that utility is additively separable in its arguments.

KEYWORDS: Multivariate Risk Preferences, Correlation Aversion, Cross-Prudence, Cross-Temperance, Risk Apportionment, Time, Fairness
JEL: D03, D81.

1. INTRODUCTION

It has long been recognized that risk attitudes play a crucial role in economic behavior. While Bernoulli (1738/1954), Arrow (1965), and Pratt (1964) have demonstrated the ubiquitous importance of risk aversion, Leland (1968), Sandmo (1970) and Kimball (1990, 1993) showed that the higher-order risk attitudes *prudence* and *temperance* complement risk aversion in important ways. For example, in the realm of saving behavior, risk aversion drives a preference to smooth consumption over time (*consumption smoothing*; Modigliani and Ando (1957)), prudence governs how saving behavior changes as future income becomes riskier (*precautionary saving*; Kimball (1990)), and temperance determines how saving behavior is affected by changes in macroeconomic risks such as interest rate risk or unemployment risk (Eeckhoudt and Schlesinger, 2008).

Within the expected utility (EU) framework, risk aversion, prudence and temperance are defined by properties of the derivatives of the utility function. However, Eeckhoudt and Schlesinger (2006) have introduced behavioral definitions in terms of observable preferences using *risk apportionment* tasks. A prudent decision maker (DM) prefers to apportion an unavoidable zero-mean risk to a high wealth state, while a temperate DM prefers to apportion two independent zero-mean risks across different states of nature. Apportioning risks is relatively simple and the resulting measurements are model-free in the sense that they retain validity if EU theory fails descriptively (e.g., see Starmer (2000)). As a result, several recent

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papers have used the risk apportionment approach to quantify higher-order risk preferences empirically, generally finding evidence for risk aversion, prudence, and to a lesser extent, temperance (Deck and Schlesinger (2010, 2014), Ebert and Wiesen (2011, 2014), Maier and Rüger (2011), Noussair et al. (2014)).

The existing literature on higher-order risk attitudes has only considered risk preferences for a single, monetary, attribute. In many important settings, DMs typically face risky alternatives with multiple, potentially non-monetary, attributes (Keeney and Raiffa (1993)). In economics, these alternatives might involve outcomes accruing sooner or later ("time preferences"), outcomes for oneself and for another person ("social preferences"), or outcomes in terms of health states or leisure time. In this paper, we demonstrate that the risk apportionment idea is general enough to elicit risk preferences over (i) non-monetary and (ii) multiple attributes, and provide empirical evidence regarding the prevalence of (higher-order) multivariate risk preferences based on this insight.

Multivariate risk preferences do not affect expected payoffs in either attribute, but identify how risk preferences over various attributes interact. For example, how does risk aversion for wealth co-vary with the DM's health state? A large amount of theoretical literature has established that the cross-risk attitudes *correlation aversion*, *cross-prudence* and *cross-temperance* are decisive in understanding the multivariate interdependency of univariate risk preferences. Correlation aversion (Richard, 1975; Epstein and Tanny, 1980) is a preference for disaggregating undesirable fixed amounts of the attributes across equiprobable states of nature. Regarding time preferences, for example, correlation aversion predicts that the DM rather faces a future wealth reduction in the state where current wealth is higher. Cross-prudence (Eeckhoudt et al., 2007) implies that the DM prefers an unavoidable zero-mean risk of one attribute in the state where she is better off in terms of the other attribute, while cross-temperance (Eeckhoudt et al., 2007) implies that the DM prefers to disaggregate two independent zero-mean risks where each risk is over a different attribute.

Analogous to the univariate case, correlation aversion, cross-prudence, and cross-temperance – or their counterparts, correlation-seeking, cross-imprudence, and cross-intemperance – are typically defined by the cross-derivatives of the utility function. Not surprisingly, these properties have been shown to play an important role in several classical models (long before they were given their name) in various economic settings. Examples include social welfare evaluations (Atkinson and Bourguignon (1982)), precautionary saving (Leland (1968)), labor supply (Eaton and Rosen (1980) and Tressler and Menezes (1980)), demand for medicare (Dardanoni and Wagstaff (1990)), demand for insurance (Eisner and Strotz (1961)), and medical treatment decisions (Bleichrodt et al. (2003)).[1] In general, only if the individual is cross-risk neutral for all orders, risk preferences are separable and utility is additive in its attributes.

[1]See Eeckhoudt et al. (2007) for a more detailed discussion of this literature.

Also note that in the same way that prudence relates to skewness-preference, cross-prudence relates to a preference for co-skewness, which plays a crucial role in asset pricing models such as Harvey and Siddique (2000), and that assumptions on the cross-derivatives of utility such as submodularity are crucial in comparative statics analysis (e.g. Milgrom and Roberts (1994), Athey (2002))); see Nocetti (forthcoming) for a recent contribution).

Despite their theoretical importance in economic decision making, there is very little empirical evidence on correlation aversion and – to best of our knowledge – no evidence for cross-prudence and cross-temperance, in any domain. The purpose of this paper is to provide a step towards filling the gap between theoretical and empirical research by measuring multivariate risk attitudes in three important economic domains, *viz.* social preferences, time preferences, and preferences regarding leisure time. More specifically, we extend the literature on risk aversion and higher-order risk preferences in several important ways. First, we provide evidence on the prevalence of (higher-order) univariate risk preferences over (i) delayed monetary transfers (ii) other people's wealth, and (iii) waiting time. Second, we provide "reduced-form" evidence on correlation aversion using the simple, model-free, risk apportionment approach. In addition, we study higher-order correlation aversion (i.e., cross-prudence and cross-temperance) in each of the aforementioned domains, which comprises the first empirical measurement on the most basic properties of multivariate risk preferences. Since risk preferences are separable and utility is additive in its attributes if and only if the DM is cross-risk neutral for all orders, our measurements also test to what extent the separability assumption is justified in each of the domains. Finally, we test *within* dimensions (wealth and time) as well as *between* dimensions the hypothesis that risk preferences root in a fundamental *preference for combining "good" with "bad"* (i.e., a preference for disaggregating harms across equiprobable states of nature), as recently conjectured in a series of papers (Eeckhoudt and Schlesinger (2006), Eeckhoudt et al. (2009), Tsetlin and Winkler (2009), Crainich et al. (2013), Deck and Schlesinger (2014)). In particular, our measurements allow us to test the robustness of this paradigm by investigating whether a preference for disaggregating goods and bads can explain risk preferences across different attributes, and by investigating whether a preference for combining "good" with "bad" prevails when more of one of the attributes (waiting time) is preferred less (i.e., is a "bad" instead of a "good").

We find pervasive risk aversion, prudence and temperance in all domains, extending previous findings to choice situations involving outcomes accruing to another person, outcomes accruing in the future, and to choice situations involving outcomes in terms of leisure time. We find correlation-aversion, cross-prudence and cross-temperance for current and delayed outcomes, as well as for monetary outcomes and outcomes in terms of waiting time. Interestingly, in the condition involving one's own wealth and other's wealth, we observe correlation-seeking and cross-intemperance and show how this relates to inequality aversion. Finally, we find evidence supporting the "good" with "bad" hypothesis, for (i) attributes other than wealth as well as (ii) between attributes, but (iii) also point out an instance, the case of multivariate case of social preferences, where the hypothesis hits its limits. Our central finding of non-neutrality of cross-risk attitudes in all domains questions the separability assumption and point to the relevance of recent theoretical work that tackles the problem of analyzing behavior when the assumption of separability is relaxed.

The remainder of this article is organized as follows. In the next section, we present the theoretical foundation of our measurements: multivariate risk apportionment. Section 3 describes the design of our measurements. The results are presented in Section 4 and are discussed and related to the literature in Section 5. Section 6 concludes. An extensive appendix (to be published online, eventually) provides further and more detailed data analysis and robustness checks.

2. THEORETICAL BACKGROUND

2.1. *Risk apportionment*

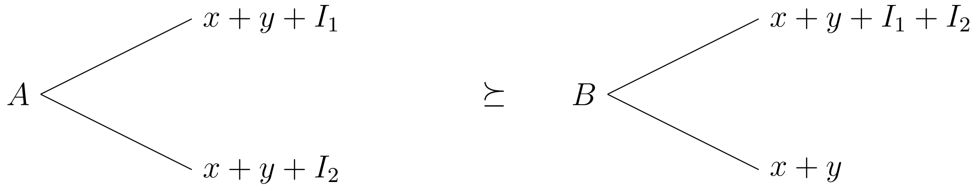
Consider an individual with an endowment x of attribute X and an endowment y of a (potentially non-monetary) attribute Y. Let I_1 and I_2 denote undesirable fixed amounts and/ or independent zero-mean risks of either X or Y (not both X and Y, i.e., all items are univariate). In the three conditions we study in this paper, the two attributes are (i) current wealth and future wealth (ii) own wealth and somebody else's wealth, and (iii) own wealth and waiting time (see Section 3). We define all attributes such that they are "goods," i.e., more is desirable.[2]

Risk apportionment, depicted as the preference $A \succeq B$ in Figure 1, corresponds to the preference for disaggregating items I_1 and I_2 across two equally likely states of nature.[3] Even when both items are fixed amounts, we follow tradition and speak of "risk" apportionment. Based on Eeckhoudt and Schlesinger (2006), Eeckhoudt et al. (2007), Eeckhoudt et al. (2009), and Tsetlin and Winkler (2009), we now show that, by choosing different combinations of items I_1 and I_2, eliciting preferences over these simple lotteries is all we need to measure univariate risk aversion, prudence, and temperance, as well as the multivariate risk preferences of correlation aversion, cross-prudence, and cross-temperance. To denote preferences like in Figure 1, let $[a; b]$ denote a lottery that yields outcomes a and b with equal probability.

[2]In particular, we define preferences over "less waiting time"; see Ebert et al. (2015) for more on risk preferences when "less is better".

[3]By slight abuse of notation, we take sums over different attributes. For example, instead of writing the endowment as (x, y) or $(x, 0)+(0, y)$, we write $x + y$. The notation in Figure 1 is less technical and close to the frame we adopt in our measurement.

Figure 1: Preference for risk apportionment



Notes. This figure illustrates the general structure of a preference for risk apportionment. x and y denote the endowments of the first and second attribute, respectively. Risk apportionment is the preference for disaggregating the items I_1 and I_2 across two equally likely states of nature. Each item is an undesirable fixed amount and/ or an independent zero-mean risks of either X or Y.

2.1.1. *Second-order risk apportionment (risk aversion)*

To define second-order risk apportionment for attribute X, let $I_1 = -x_1 < 0$ and $I_2 = -x_2 < 0$ be two fixed (undesirable) reductions of X. Second-order risk apportionment for attribute X is thus the preference $A = [x+y-x_1; x+y-x_2] \succeq B = [x+y-x_1-x_2; x+y]$ for all x, y, x_1 and x_2. Consistent with the idea of diminishing marginal sensitivity, this means that any single, unavoidable reduction in x is preferred when the decision maker has more of X. An alternative interpretation is that the decision maker prefers to apportion two "harms" in different rather than in the same of two possible states of nature.

Eeckhoudt and Schlesinger (2006) show that an individual is risk-averse if and only if she exhibits second-order risk apportionment. Lottery A is easily shown to be a mean-preserving contraction in the sense of Rothschild and Stiglitz (1970). If the decision maker's preferences can be represented by EU with a smooth utility function u, it is well known that risk aversion is characterized by utility being concave, i.e., by $u_{xx} \leq 0$.[4] Second-order risk apportionment for attribute Y is defined analogously.[5]

The concept of correlation aversion dates back to Richard (1975) and Epstein and Tanny (1980). Eeckhoudt et al. (2007) note that correlation aversion is the natural multivariate extension of univariate second-order risk apportionment as proposed in Eeckhoudt and Schlesinger (2006). Indeed, to characterize correlation aversion simply let $I_1 = -x_1 < 0$ be a fixed reduction in X and $I_2 = -y_1 < 0$ be a fixed reduction in Y. Correlation aversion is defined by the preference $A = [x + y - x_1; x + y - y_1] \succeq B = [x + y - x_1 - y_1; x + y]$

[4] Since this paper concerns utility over two attributes X and Y, we let $u(x, y)$ denote the utility function, and let u_x and u_y denote $\frac{\partial u}{\partial x}$, and $\frac{\partial u}{\partial y}$, respectively. We follow the same convention for higher-order (cross-) derivatives, e.g., $u_{xxy} \equiv \frac{\partial^3 u}{\partial x^2 \partial y}$.

[5] Specifically, let $I_1 = -y_1 < 0$ and $I_2 = -y_2 < 0$ be two fixed reductions of attribute Y. Second-order risk apportionment over Y is equivalent to risk aversion for Y; within smooth EU this preference corresponds to $u_{yy} \leq 0$. In the definition of univariate risk preferences for attribute X, attribute Y merely plays the role of a "background endowment" since the individual's decision does not affect the attribute Y outcome, and vice versa. This is also true for the third- and fourth-order risk apportionment choices studied below.

for all x, y, x_1, and y_1. For example, if attribute X is current wealth and Y is future wealth (as in our first measurement condition), correlation aversion (seeking) implies that a fixed reduction in future wealth is less (more) harmful when current wealth is higher.

Within the EU framework, correlation aversion (correlation-seeking) corresponds to $u_{xy} \leq 0$ ($u_{xy} \geq 0$).[6] In the monotone comparative statics literature, the former (latter) property is known as submodularity (supermodularity). Correlation aversion is necessary for utility being separable across attributes (i.e., $u(x, y) = u(x)+u(y)$). However, correlation-neutrality is by no means sufficient for separability, which also requires cross-risk neutrality of the higher orders discussed next.

2.1.2. *Third-order risk apportionment (prudence)*

Prudence for X (Y) is defined via risk apportionment by letting $I_1 = -x_1 < 0$ ($I_1 = -y_1 < 0$) be a reduction in X (Y), and $I_2 = \tilde{x}_2$ ($I_2 = \tilde{y}_2$) be a zero-mean risk over X (Y). Prudence for attribute X is thus defined by the preference $[x+y-x_1; x+y+\tilde{x}_2] \succeq [x+y-x_1+\tilde{x}_2; x+y]$ for all possible X, Y, x_0, and zero-mean risks $\tilde{x}_2$. Under smooth EU, prudence is characterized by convex marginal utility, i.e., by $u_{xxx} \geq 0$.[7]

Univariate prudence for wealth is equivalent to downside risk aversion (Menezes et al. (1980)), and implies a preference for positive skewness.[8] Prudence is necessary but not sufficient for decreasing absolute risk aversion. Indeed, third-order risk apportionment for wealth just means that an unavoidable, additional zero-mean risk is relatively more preferred when wealth is higher. Prudence is necessary and sufficient for a precautionary savings motive (Sandmo (1970)).

For the third order, the univariate risk apportionment idea can be extended to the multivariate case in two ways. The first is to let $I_1 = -x_1 < 0$ and $I_2 = \tilde{y}_2$, i.e., to let the individual apportion a fixed reduction in X and a zero-mean Y risk. The preference

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[6]Following Eeckhoudt et al. (2007), note that $u_{xy} \leq 0$ for all x, y is equivalent to

$$u(x, y - y_1) - u(x - x_1, y - y_1) \geq u(x, y) - u(x - x_1, y)$$

for all fixed reductions $-x_1$ and $-y_1$ in the respective attribute. This means that losing x_1 hurts more when the second attribute is low ($y - y_1$ on the l.h.s.) than when it is high (y on the r.h.s.). Rearranging and multiplying by 0.5 yields precisely the lottery preference in Figure 1 – expressed in expected utility terms – for $I_1 = -x_1$ and $I_2 = -y_1$.

[7]Eeckhoudt and Schlesinger (2006) illustrate the equivalence for prudence as follows (cf. also Noussair et al. (2014)). Let x denote wealth, $\tilde{\epsilon}$ be a mean zero risk, and $w(x)$ be the utility premium (cf. Friedman and Savage (1948), the change in expected utility from taking on a lottery with mean zero) for an expected utility maximizer. Then $w(x) \equiv Eu(x+\tilde{\epsilon})-u(x)$, and, by Jensen's inequality, $w(x) \leq 0$ iff $u_{xx} \leq 0$. That is, the utility premium is negative for a risk-averse individual. Differentiating both sides yields $w_x(x) \equiv Eu_x(x+\tilde{\epsilon})-u_x(x)$. It follows, again by Jensen's inequality, that $w_x(x) \geq 0$, iff $u_{xxx} \geq 0$. Thus, the utility premium is increasing in x, if and only if the individual is prudent. In other words, a prudent expected utility maximizer prefers to take on an unavoidable risk in a relatively high income state.

[8]Ebert (2013b) provides a comprehensive analysis of risk apportionment in terms of statistical moments. Third-order risk apportionment lotteries never differ in mean and variance, and prudence implies a preference for the lottery with larger skewness.

$[x+y-x_1; x+y+\tilde{y}_2] \succeq [x+y-x_1+\tilde{y}_2; x+y]$, is called cross-prudence for attribute X and is equivalent to $u_{xyy} \geq 0$ within smooth EU.[9] If X is current wealth and Y is future wealth (as in our first measurement condition), cross-prudence for X ensures precautionary saving in the seminal model of Leland (1968). As another example, if attribute X is wealth and attribute Y is waiting time (as in our second measurement condition), cross-prudence for X implies that the decision maker can better cope with an unavoidable zero-mean risk in waiting time if wealth is higher. The second option would be to let $I_1 = -(-y_1) = y_1 > 0$ (a fixed reduction in *less* waiting time, i.e., more waiting time) and $I_2 = \tilde{x}_2$. Then the individual decides about how to apportion an increase in waiting time and a zero-mean risk in wealth. The preference $[x+y+y_1; x+y+\tilde{x}_2] \succeq [x+y+y_1+\tilde{x}_2; x+y]$ is called cross-prudence for Y and implies, here, that the individual prefers to bear an unavoidable wealth risk when waiting time is low.

2.1.3. *Fourth-order risk apportionment (temperance)*

Fourth-order risk apportionment, or temperance, comprises the case where both items are independent zero-mean risks. Temperance for attribute X is defined by the preference $[x+y+\tilde{x}_1; x+y+\tilde{x}_2] \succeq [x+y+\tilde{x}_1+\tilde{x}_2; x+y]$, where $\tilde{x}_1$ and $\tilde{x}_2$ are independent zero-mean X risks (analogously for attribute Y.) A temperate individual perceives independent risks as mutually aggravating and thus prefers to disaggregate them across states of nature. Under EU with a smooth utility function u, temperance for X and temperance for Y correspond to $u_{xxxx} \leq 0$ and $u_{yyyy} \leq 0$, respectively. Temperance is necessary for outer risk aversion (Menezes and Wang (2005)) – aversion to kurtosis and fat-tailed risks[10] – as well as for the normatively desirable properties of proper and standard risk aversion (Pratt and Zeckhauser (1987); Kimball (1993)).

To characterize fourth-order cross-risk apportionment simply take as items a zero-mean risk of either attribute: $I_1 = \tilde{x}_1$ and $I_2 = \tilde{y}_1$. Cross-temperance is defined by the preference $[x+y+\tilde{x}_1; x+y+\tilde{y}_1] \succeq [x+y+\tilde{x}_1+\tilde{y}_1; x+y]$. For example, in the case where X concerns own wealth and Y the wealth of somebody else (as in our third measurement condition), cross-temperance implies that the DM is averse to aggregating own- and others' risks. Within smooth EU, cross-temperance is equivalent to $u_{xxyy} \leq 0$. Table I summarizes the univariate and multivariate (higher-order) risk preferences studied in this paper and the conditions on

[9] Following Eeckhoudt et al. (2007), consider the utility premium $v(x,y) = u(x,y) - Eu(x, y+\tilde{y}_2)$. Taking the derivative with respect to x yields $v_x(x,y) = u_x(x,y) - Eu_x(x, y+\tilde{y}_2)$. By Jensen's inequality $v_x(x,y) \leq 0$ for all (x,y) if and only if u_x is convex in y, i.e., $u_{xyy} \geq 0$. But note that $v_x \leq 0$ is equivalent to

$$u(x,y) - Eu(x, y+\tilde{y}_2) \leq u(x,y) - Eu(x-x_1, y+\tilde{y}_2) \text{ for all } x_1 > 0.$$

Rearranging and multiplying by 0.5 yields the lottery preference definition of cross-prudence for X.

[10] Fourth-order risk apportionment lotteries have equal mean, variance, and skewness. Temperance implies a preference for the lottery with smaller kurtosis; see Ebert (2013b).

the (cross-) derivatives of the utility function under EU.

TABLE I
UNI- AND MULTIVARIATE RISK PREFERENCES

Trait	Stage	Task	I_1	I_2	EU condition	RA	RL
Risk aversion for X	RA	RA-X	$-x_1$	$-x_2$	$u_{xx} \leq 0$	Yes	No
Risk aversion for Y	RA	RA-Y	$-y_1$	$-y_2$	$u_{yy} \leq 0$	Yes	No
Correlation aversion	RA	X-RA	$-x_1$	$-y_1$	$u_{xy} \leq 0$	Yes	No
Prudence for X	PR	PR-X	$-x_1$	$\tilde{x}_1$	$u_{xxx} \geq 0$	Yes	Yes
Prudence for Y	PR	PR-Y	$-y_1$	$\tilde{y}_1$	$u_{yyy} \geq 0$	Yes	Yes
Cross-prudence for X	PR	X-PR-X	$-x_1$	$\tilde{y}_1$	$u_{xyy} \geq 0$	Yes	Yes
Cross-prudence for Y	PR	X-PR-Y	$\tilde{x}_1$	$-y_1$	$u_{xxy} \geq 0$	Yes	Yes
Temperance for X	TE	TE-X	$\tilde{x}_1$	$\tilde{x}_2$	$u_{xxxx} \leq 0$	Yes	No
Temperance for Y	TE	TE-Y	$\tilde{y}_1$	$\tilde{y}_2$	$u_{yyyy} \leq 0$	Yes	No
Cross-temperance	TE	X-TE	$\tilde{x}_1$	$\tilde{y}_1$	$u_{xxyy} \leq 0$	Yes	No

Notes. Table I summarizes the 10 univariate and multivariate higher-order risk preferences studied in this paper. RA (PR, TE) refers to risk aversion (prudence, temperance) and task names beginning with an "X" denote cross-traits. $-x_1$ and $-x_2$ ($-y_1$ and $-y_2$) denote undesirable fixed amounts of attribute X (Y) and $\tilde{x}_1$ and $\tilde{x}_2$ ($\tilde{y}_1$ and $\tilde{y}_2$) denote independent zero-mean X (Y) risks. The sixth column shows the characterizing derivative condition if smooth EU is assumed. The last two columns show the behavioral predictions for individuals who are, respectively, risk averters (RA) and risk lovers (RL) for both X and Y according to the theory of "consistent" risk preferences (see Section 2.2).

2.2. *Consistency of multivariate higher-order risk preferences*

By adding two additional "zero items" to the general risk apportionment preference depicted in Figure 1, we can write it as

$$A = [x + y + I_1 + 0; x + y + I_2 + 0] \succeq B = [x + y + I_1 + I_2; x + y + 0 + 0]. \quad (1)$$

Consider univariate risk apportionment of order 2. Relative to the "bad" fixed amounts $I_1 = -x_1 < 0$ and $I_2 = -y_1 < 0$, the zeros are "good." Lottery A in equation (1) combines, in each of the two states of nature, a "good" zero with a "bad" fixed reduction of one of the attributes. Lottery B, on the other hand combines the two "bad" items in one state and the two "good" zeros in the other. Eeckhoudt et al. (2009) formalized how risk apportionment relates to a preference for combining "good"with "bad". Assuming that zero-mean risks are bad, risk apportionment of order 3 and 4, i.e., prudence and temperance, are also generated by a preference for combining "good" with "bad".

But zero-mean risks are bad only if the individual is risk-averse. Crainich et al. (2013) show that risk-lovingness relates to a preference for combining "good" with "good" (and "bad"with "bad"). They then show that both risk averters who consistently like to combine "good" with "bad" (called mixed risk averters; Caballé and Pomansky (1996)) as well as risk lovers who consistently like to combine "good" with "good" (called mixed risk lovers) are prudent, but that mixed risk averters are temperate and mixed risk lovers are intemperate; see also Ebert (2013a). This dichotomy of *consistent risk preferences* was confirmed experimentally by Deck and Schlesinger (2014) and received some additional support by Ebert and Wiesen (2014).

Our data collected from three different domains allow us to test whether risk preferences are consistent domain-independently. Moreover, we can test whether consistency extends to multivariate risk apportionment, as outlined by Tsetlin and Winkler (2009). We now derive the predictions for cross-risk attitudes in our experiment for subjects who consistently prefer to combine either "good with bad" or "good with good", for both attributes X and Y. Analogously to the univariate case, we baptize the former (latter) individuals *bivariate mixed risk averters (lovers).*

Starting at the second order, a bivariate mixed risk averter combines the "good" zero with the "bad" X-item in one state and the other "good" zero with the "bad" Y-item in the other state. Therefore, a preference for combining "good" with "bad" not only implies risk aversion for either attribute, but also correlation aversion. Bivariate mixed risk lovers who like to combine "good" with "good" will always combine the "good" zeros in one state and the "bad" items in the other state. Therefore, bivariate risk lovers are (indeed) risk-loving for both X and Y, but also correlation-seeking.

Turning to the third order, consider the apportionment of a fixed reduction in wealth and a zero-mean waiting time risk as an example. The multivariate mixed risk averter is – as we just showed – risk-averse for waiting time so that zero-mean waiting time risk is "bad." Since he likes to combine "good" with "bad", he disaggregates the items across states of nature, chooses A in equation (1), thus being cross-prudent for wealth. The mixed risk lover finds the reduction in wealth "bad", but – as we just showed – the zero-mean risk "good". Because he likes to combine "good" with "good", he does *not* want to combine the "bad" reduction in wealth with the "good" zero-mean risk as in choice B in equation (1). Therefore, also the mixed risk lover chooses A and is cross-prudent for wealth. Therefore, both multivariate mixed risk averters and lovers are cross-prudent, even though for different reasons: the former like to combine "good" with "bad" and the latter like to combine "good" with "good". This somewhat surprising result is the multivariate analogue to the Crainich et al. (2013) finding that "even mixed risk lovers are prudent."

Continuing the above reasoning shows that multivariate mixed risk averters and lovers are cross-prudent for the other attribute, but that the former are cross-temperate while the latter are cross-intemperate. The last two columns of Table I summarize the behavioral predictions of the (multivariate) consistency hypothesis derived in this section.

3. EXPERIMENTAL DESIGN

3.1. *Participants*

The experiment was conducted at Tilburg University, the Netherlands.[11] In total, 312 subjects took part; 101 participated in the *Intertemporal* condition, 109 participated in the *Waiting* condition, 102 in the *Social* condition (see below). Subjects were only allowed to participate in one of the conditions. The mean age of subjects was 22 years, while 50% were female.

3.2. *Measurement Conditions*

In the *Intertemporal condition*, subjects faced lotteries yielding monetary outcomes in cash at the end of the experiment and monetary outcomes transferred to the bank account of subjects in 21 days. Paying in cash and by bank transfer in 21 days served to make the difference in payments accruing at different points in time in terms of transaction costs and trustworthiness of payment particularly salient.

In the *Waiting condition*, subjects faced lotteries yielding monetary outcomes (in euros) and outcomes in waiting time (in minutes). At the start of the experiment, subjects were randomly allocated to an isolated room with a single computer and were asked to leave their possessions outside their private cubicle. Subjects had to wait their earnings in waiting time in their cubicle after the experiment and were not allowed to do anything (e.g., read, write, use the computer or their cellphone) while waiting. The waiting time started the moment the experiment was finished. Experimental earnings were transferred to subjects' bank accounts on the same day.

In the *Social condition*, subjects faced lotteries yielding monetary outcomes (in euros) for themselves and for another participant of the experiment. At the start of the experiment, subjects were randomly matched with another participant of the experiment. The identity of the other participant was never revealed to subjects. Importantly, subjects were informed that with equal chance, either their choice or the choice of the other participant in the randomly chosen task was implement for real. Thus, earnings of the subjects in the Social condition were either determined by their own decision or by the decision made by the other participant. As in the Waiting condition, experimental earnings were transferred to subjects' bank accounts on the same day.

3.3. *Choice Tasks*

The main experiment consisted of three stages. At the start of each stage, instructions were distributed on paper and read aloud. The first stage consisted of 9 choice tasks to

[11] The experiment was programmed in z-Tree Fischbacher (2007)

gauge individual attitudes towards risk (second-order risk apportionment). The second stage consisted of 12 choice tasks designed to obtain individual measures of the degree of (cross-) prudence (third-order risk apportionment). The third stage was designed to elicit individual degrees of (cross-) temperance (fourth-order risk apportionment) and consisted of 9 choice tasks. Depending on the condition a fourth stage with up to three additional choices followed, which we explain when making use of this choice data.

All risks involved in the experiment were equiprobable and were determined by a roll of the die (odd or even), by the color of a card (black or red) drawn at random form a deck of 5 red and 5 black playing cards, or by the color of a ball (yellow or white) drawn at random from an opaque bag containing 5 yellow and 5 white balls. In order to keep the framing of the lotteries as close as possible to the existing literature on higher order risk attitudes, the lotteries were presented in compound format.[12] Tables X to XII in Appendix F present each of the 30 choices that were used to measure preferences for (higher-order) risk apportionment in each condition. A screenshot can be found in Appendix E.

3.4. *Treatments and Controls*

To test the robustness of preferences for (higher-order) risk apportionment, subjects were randomly assigned to treatments (similar to Ebert and Wiesen (2011, 2014)). In particular, the domain (increases or decreases) of fixed amount items was varied systematically across treatments.[13] Expected payments for each choice were kept constant across treatments by varying the endowments. The position of the lotteries on the screen (left or right) as well as the winning roll (odd or even) were randomly determined for each question, in order to control for potential preferences for a particular position of the lotteries or outcomes of the dice.

3.5. *Payment*

At the end of the experiment, one choice of each subject was randomly selected to be paid for real. For this purpose, at the start of the experiment one subject was asked to randomly draw and sign an envelope from a pile of sealed envelopes, each containing a numbered card. Subjects were told that the envelope would be opened at the end of the experiment and that the choice corresponding to the number on the card inside the envelope would determine

[12] The compound frame makes the choice of whether to aggregate or disaggregate items explicit (e.g., Deck and Schlesinger (2014)). Maier and Rüger (2011) employ the risk apportionment lotteries in reduced form and obtain very similar results.

[13] While in Section 2 we assumed that all fixed amounts were undesirable, risk apportionment theory is robust to using desirable items for one or both attributes instead. We test for this in a 2x2 between-subject factorial design for each condition. See Appendix F for parameter details and Appendix C for the analysis.

the earnings.[14] Subjects were paid a show-up fee of €4 on top of their choice-contingent earnings. In the Intertemporal condition, half the show-up fee was paid to subjects in cash at the end of the experiment; the other half was transferred to their bank account in 21 days. On average, subjects earned €9.15 in cash and had €8.83 transferred to their bank account 21 days after the experiment in the Intertemporal condition, while subjects earned €24.70 and waited 20 minutes in the Waiting condition. In the Social condition, the average earnings were € 20.90.

4. RESULTS

4.1. *Univariate Risk Preferences*

In line with Noussair et al. (2014) and Deck and Schlesinger (2014), we use the amount (out of the three) choices in each of the 10 tasks that subjects answered in the (higher-order and uni- or cross-) risk-averse way as our measurement of uni- and multivariate risk preferences. The distribution of aggregate choices in the Intertemporal, Waiting, and in the Social condition can be found in Figure 2, Figure 3 and Figure 4, respectively. Table II presents the average number of risk-averse, correlation-averse, (cross-) prudent and (cross-) temperate choices that subjects made in each condition.

Rows 1 to 3 show the uni-variate risk preferences in the Intertemporal condition (column 2), in the Waiting condition (column 3), and in the Social condition (column 4) for current, own wealth. The main differences between conditions for these tasks were the background endowments (in waiting time, future wealth and wealth for someone else) and the size of the monetary amounts.[15] As can be seen in the table, a significant majority of decisions are consistent with risk aversion, prudence, and temperance for wealth in all conditions. The only exception is for temperance for wealth in the Intertemporal condition. Prudence for wealth appears to be most prevalent. In Appendix A, we study risk preferences for own, current wealth in more detail.

Rows 4-6 presents the results regarding risk preferences for future wealth, waiting time, and wealth of somebody else. We find strong evidence for risk aversion and prudence for (monetary) outcomes accruing in the future. It appears, however, that decision makers are temperate neutral for future wealth.

[14]This procedure prevents confounding income effects – such as Thaler and Johnson's (1981) house money effect – that might arise if more than one task is being paid. Starmer and Sugden (1991) provide evidence that selecting one decision for payment, rather than all decisions, does not affect choice behavior. As a result, this procedure is nowadays most often used in experiments designed to measure individual risk preferences (e.g., Myagkovi and Plott (1997); Holt and Laury (2002)). Randomly selecting the task that is paid for real at the start of the experiment (without subjects knowing which task that is) further enhances isolation Johnson et al. (2015).

[15]Relative to the Social condition, stakes in the Waiting condition were slightly higher to compensate subjects for having to wait in the cubicle. The immediate stakes in the Intertemporal condition were half the size of those in the Social condition to account for the fact that each subject received an additional amount

TABLE II

Average Behavior Across Conditions

Task	Intertemporal	Waiting	Social
RA-X	1.93***	2.24***	1.92***
PR-X	2.14***	2.53***	2.45***
TE-X	1.72*	1.94***	1.91***
RA-Y	1.89***	2.35***	1.97***
PR-Y	2.18***	2.23***	1.98***
TE-Y	1.66	2.15***	1.76***
X-RA	1.92***	2.17***	0.85***
X-PR-X	2.12***	2.27***	1.58
X-PR-Y	2.11***	2.45***	1.38
XTE	1.84***	1.64	0.91***
N	101	109	102

Notes. Table II presents the mean number of (higher-order and cross-) risk-averse choices out of the 3 choices in each of the 10 choice tasks (rows 1 to 10) in the Intertemporal condition (column 2), in the Waiting condition (column 3), and in the Social condition (column 4). In the Intertemporal condition, attribute X concerned monetary outcomes today in cash and attribute Y concerned monetary outcomes by bank transfer in 21 days. In the Waiting condition, attribute X concerned monetary outcomes and attribute Y concerned outcomes in terms of waiting time. In the Social condition, attribute X concerned monetary outcomes for oneself and attribute Y concerned monetary outcomes for somebody else. RA (PR, TE) refers to risk aversion (prudence, temperance) and a preceding "X" indicates a cross-trait. *** (**,*) indicates significance at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests. Two-sided t-tests yield similar results.

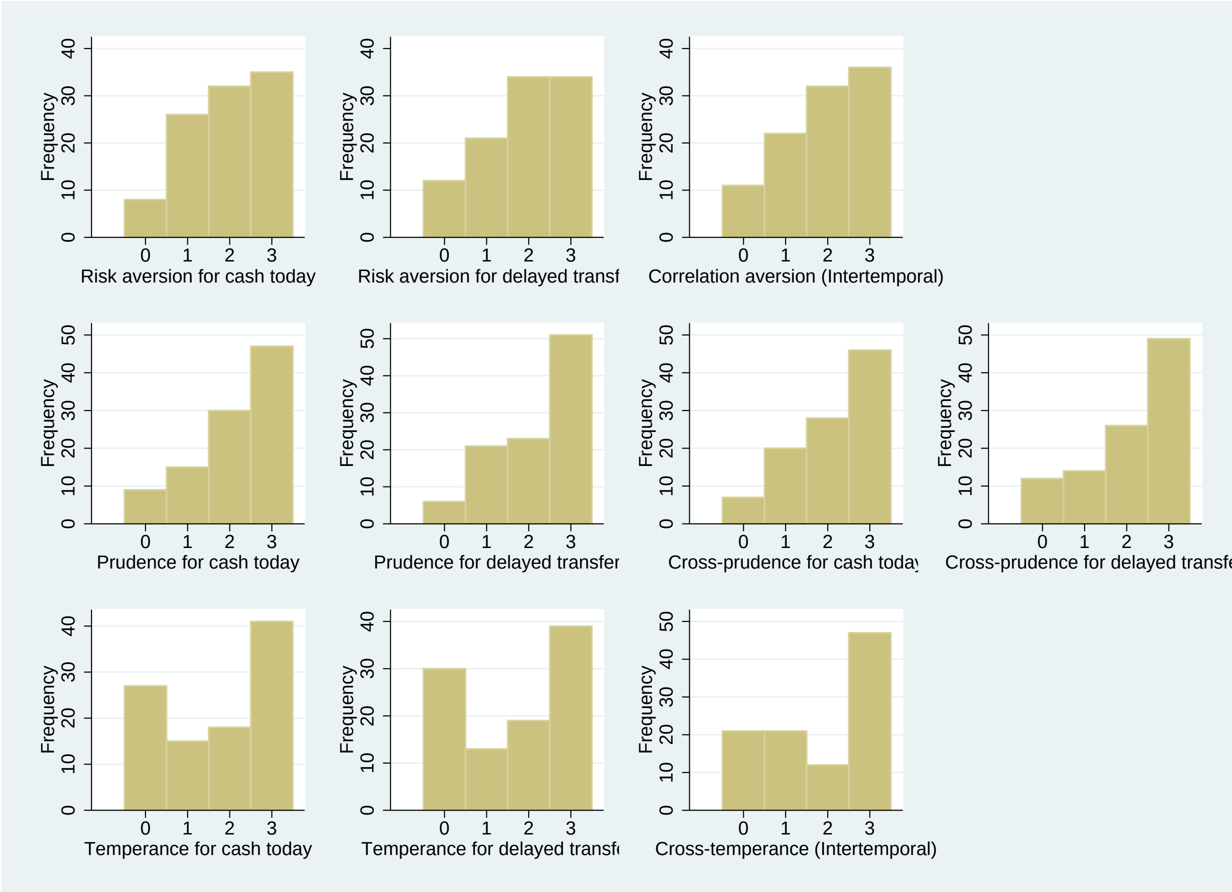
For waiting time, we again find evidence for risk aversion, prudence, and temperance. In fact, strong risk aversion, prudence, and temperance, with all three choices consistent with the attitude, are the modal choice profile. When others' wealth is at stake, rows 4-6 in column 4 show that individuals also behave in a risk-averse, prudent, and temperate manner. Overall, the evidence suggests that established pattern of risk aversion, prudence, and temperance – that has been established in a few experiments by now – extends from the domain of current, own wealth other (and quite different) attributes.

4.2. *Multivariate Risk Preferences*

Rows 7 to 10 of Table II present results on cross-risk preferences for current and future wealth (column 2), for wealth and waiting time (columns 3) and for own wealth and others' wealth (column 4). As can be seen in the table, in the Intertemporal condition, the mean response is indicative of a preference for correlation aversion. This implies that individuals can better cope with a future reduction in wealth when current wealth is high. In addition, row 8 shows that individuals can not only better cope with an unavoidable zero-mean future wealth

in the future; see Appendix F for details.

Figure 2: Higher-order univariate and cross-risk attitudes in the Intertemporal Condition

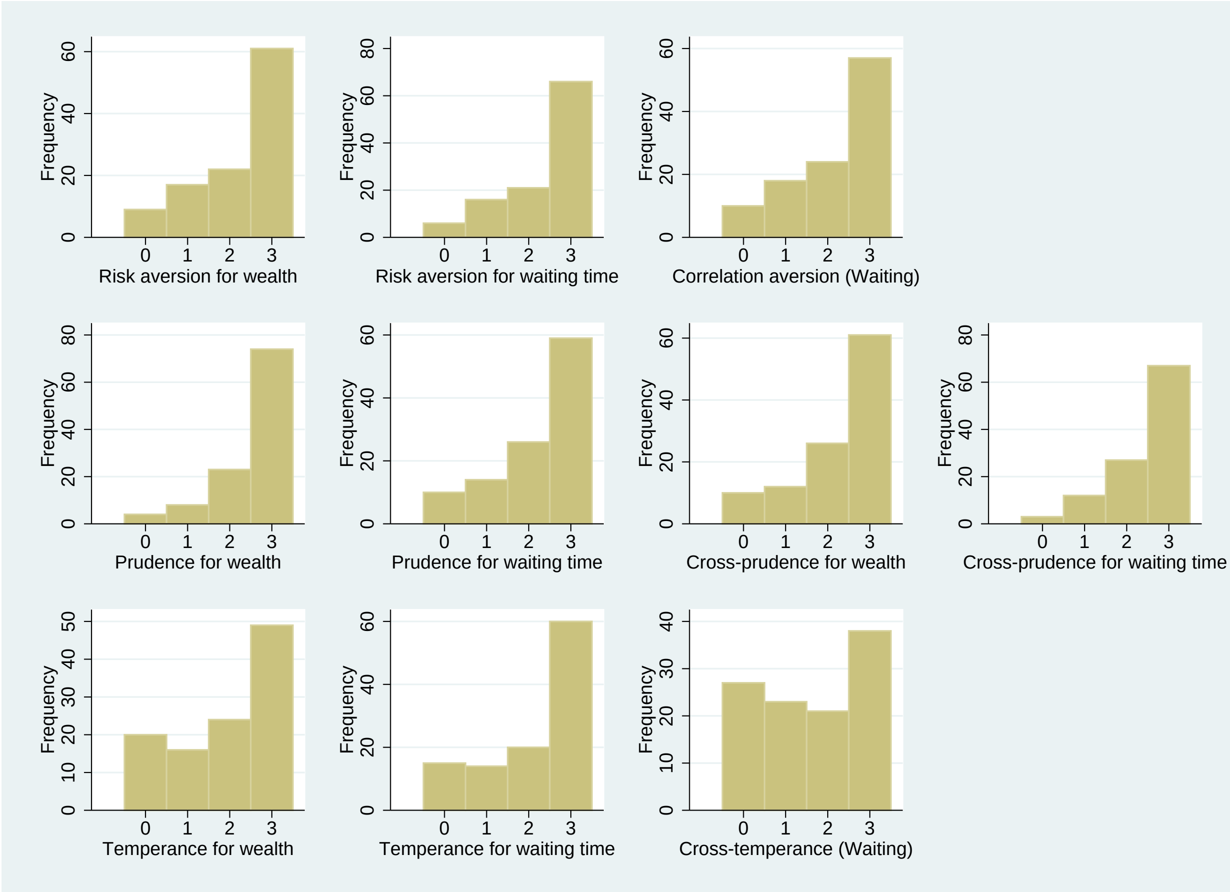


Notes. This figure shows aggregate choices in the Intertemporal condition. The first (second, third) row shows the distribution of second- (third-, fourth-) order risk preferences. The first (second) column shows the distribution of univariate risk preferences for cash today (money transferred later). The final two columns show the distribution of cross-risk attitudes for these attributes.

risk if current wealth is high, but they also prefer to face a current zero-mean wealth risk when future wealth in high, i.e., they are cross-prudent for current wealth and cross-prudent for future wealth. This result is important, since it provides a motive to save precautionary; if future income becomes riskier, individuals will prefer to save more in order to better cope with the future income risk (Leland (1968)). Finally, even though individuals appear to be temperate neutral for current wealth and future wealth, they are cross-temperate for these attributes. That is, even though individuals do not exhibit a strong preference for aggregating two independent current wealth risks or two independent future wealth risks, they dislike aggregating a current wealth risk and a future wealth risk.

In the Waiting condition, cross-risk preferences follow the stylized pattern of risk aversion, prudence, and mild (here, insignificant) temperance that is observed in the univariate case for each attribute. This means that, on the aggregate, individuals prefer unavoidable additional waiting time when having more wealth, i.e., they are correlation-averse. Likewise, they prefer

Figure 3: Higher-order univariate and cross-risk attitudes in the Waiting Condition

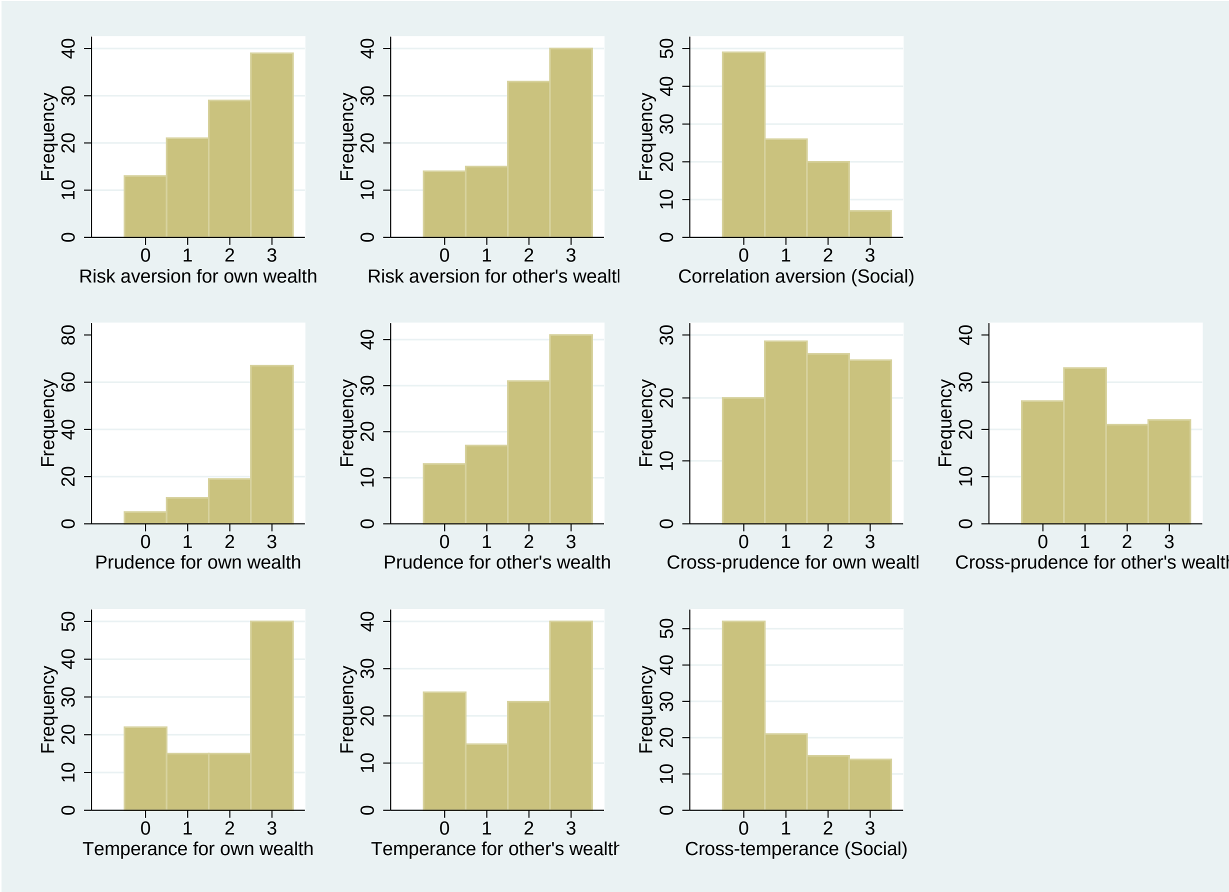


Notes. This figure shows aggregate choices in the Waiting conditions. The first (second, third) row shows the distribution of second- (third-, fourth-) order risk preferences. The first (second) column shows the distribution of univariate risk preferences for money (reduced waiting time). The final two columns show the distribution of cross-risk attitudes for these attributes.

to face an unavoidable zero-mean risk over one attribute in the state where the other attribute is better, i.e, they are cross-prudent for both wealth and waiting time. If an attribute is bad in one state, subjects prefer compensating it with more of the other attribute in that state, rather than using it to improve the better state. That is, subjects prefer to compensate a "bad" in one attribute by means of a "good" of another attribute. Finally, individuals do not appear to have a strong preference toward aggregating or dis-aggregating wealth and waiting time risks as they are neither cross-temperate nor cross-intemperate in the Waiting condition.

Interestingly, in the Social condition, we observe significant correlation-seeking and cross-intemperance, while subjects appear to be cross-prudent neutral for either attribute. Subjects prefer to receive an additional unavoidable loss in the same state where the other subject receives a loss. In the Social condition, correlation-seeking relates to inequality aversion of outcome. In section 5, we also discuss how cross-intemperance is indicative of process fairness.

Figure 4: Higher-order univariate and cross-risk attitudes in the Social Condition



Notes. This figure shows aggregate choices in the Social condition. The first (second, third) row shows the distribution of second- (third-, fourth-) order risk preferences. The first (second) column shows the distribution of univariate risk preferences for own money (other's money). The final two columns show the distribution of cross-risk attitudes for these attributes.

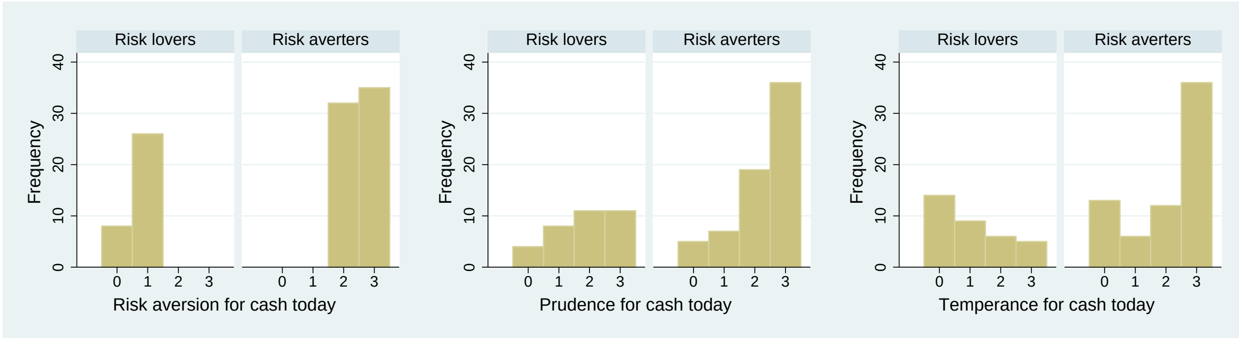
4.3. *Consistency of Risk Preferences*

4.3.1. *Univariate Consistency*

To get a first impression of how preferences for combining "good" with "bad" reflect in the data, Figure 5 shows risk aversion, prudence, and temperance for current wealth in the Intertemporal condition, separately for risk averters and risk lovers. Recall the predictions derived in Section 2.2 and summarized in Table I. If preferences are consistent with a preference for combining "good" with "bad", risk averters should be prudent and temperate while risk lovers should also be prudent, but intemperate. This is indeed the pattern suggested in Figure 5.

The upper left panel of Table III summarizes the means of choices in Figure 5 and results from Wilcoxon signed-rank tests whether choices are random. By definition, risk averters (risk lovers) are significantly risk-averse (risk-loving) with a mean of 2.52 (0.76) choices. As the

Figure 5: Univariate prudence and temperance for wealth in Condition Intertemporal for risk averters and risk lovers separately



Notes. This figure illustrates (higher-order) risk preferences for wealth X in Condition Intertemporal for risk averters and risk lovers who made made 2 or 3 (resp. 0 or 1) choices in Task RA-X; see the first column of the figure. Choices in Task PR-X are shown in the second column while choices in Task TE-X are shown in the third column.

histograms in Figure 5 suggest, as hypothesized by Crainich et al. (2013) and first confirmed by Deck and Schlesinger (2014), both risk lovers and risk averters are significantly prudent, but risk averters are significantly temperate while risk lovers are significantly intemperate.

TABLE III

UNIVARIATE CONSISTENCY

	Intertemporal			Waiting			Social		
	RA	PR	TE	RA	PR	TE	RA	PR	TE
Risk Preference for attribute X (own wealth)									
mean (RA)	2.52***	2.28***	2.06***	2.73***	2.60***	2.12***	2.57***	2.53***	1.97***
mean (RL)	0.76***	1.85**	1.06**	0.65***	2.31***	1.35	0.62***	2.29***	1.79
Risk Preference for attribute Y (money later, waiting time, other's wealth)									
mean (RA)	2.50***	2.22***	1.87**	2.76***	2.17***	2.21***	2.55***	2.11***	1.92***
mean (RL)	0.64***	2.09***	1.24	0.73***	2.45***	1.91	0.52***	1.66	1.38

Notes. Table III presents – for risk averters and risk lovers separately – the mean number of (higher-order) risk-averse choices in the Intertemporal condition (column 2), in the Waiting condition (column 3), and in the Social condition (column 4). The upper panel is for attribute X (current, own wealth) while the lower panel is for attribute Y (delayed monetary transfer, waiting time, or other's wealth). By definition, risk averters (risk lovers) for X made 2 or 3 (0 or 1) risk-averse choices for Task RA-X. Likewise, risk averters (risk lovers) for Y made 2 or 3 (0 or 1) risk-averse choices for in Task RA-Y. In condition Intertemporal (Waiting, Social), there are 67 (83, 68) risk averters for X and 34 (26, 34) risk lovers for X. For attribute Y these numbers correspond to 68 (87, 73) risk averters and 33 (22, 29) risk lovers. *** (**,*) indicates significant difference from 1.5 at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests.

Turning to conditions Waiting and Social, we also find with significance that risk averters are prudent and temperate. We also find with significance that risk lovers are prudent, but find no significant evidence regarding temperance. This was also the case in the analysis reported in Ebert and Wiesen (2014). Since the number of risk lovers observed is typically small, results are much less reliable. Also note that, if a subject chooses randomly he has an equal chance of being coded as a risk averter or risk lover, thus diluting the risk lover sample relatively more. A general observation from our data (in this instance and also later) is strong support for the large group of risk averters behaving consistently with the good-with-bad idea, while for risk lovers we not always obtain significant results. Whenever we do obtain significant results for risk lovers, however, they go in the right direction. There is no instance (in no condition, in no univariate and in no multivariate test) of a significant violation of the good-with bad prediction.

We now turn to the analysis of the novel attributes, i.e., delayed payment, waiting time, and other's wealth. Figure 6 shows the distribution of (higher-order) risk-averse choices for risk averters and risk lovers separately. The mean of choices and test statistics are shown in the lower panel of Table III. For each attribute, the majority of subjects is risk-averse. These risk averters make prudent and temperate choices at higher orders, as is predicted by Crainich et al. (2013). These results extend Deck and Schlesinger (2014) from the domain of current, own wealth to the domains of (i) future wealth, (ii) waiting time, (iii) and other's wealth.

Risk lovers for, respectively, future wealth and waiting time are significantly prudent, but the predicted intemperance is insignificant. Finally, regarding other's wealth, the numbers for risk lovers point into the right direction (prudence and intemperance), but neither number is significant. Overall, for the majority of risk averters we find strong evidence for a preference for combining "good" with "bad", as regards both prudence and temperance, and across all domains. For risk lovers, similarly to before, not all predictions are observed with significance, many are, and no prediction is violated with significance.

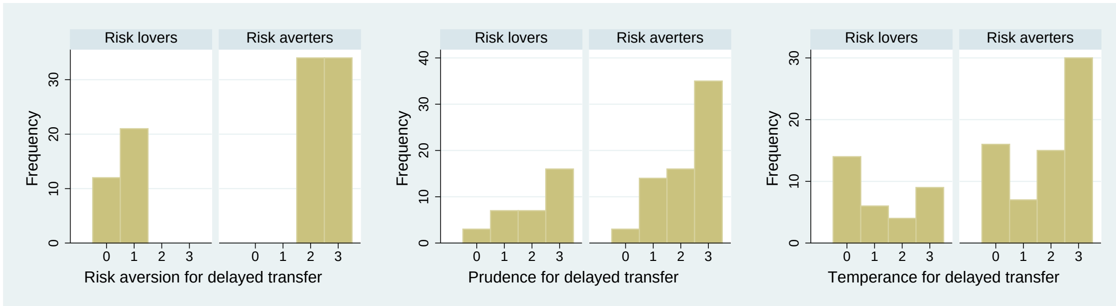
4.3.2. *Multivariate Consistency*

In this section, we investigate whether bivariate risk averters' preferences are consistent with a preference for combining "good" with "bad". To fix ideas, let us start again by looking at histograms for the Intertemporal condition, Figure 7. Making use of matrix notation, the first two panels (1,1) and (1,2) show that we defined risk averters (risk lovers) as risk-averse (risk-loving) for *both* cash today and delayed payment. This reduces the sample from 101 subjects to 68 subjects, out of which 51 are risk averters and 17 are risk lovers.

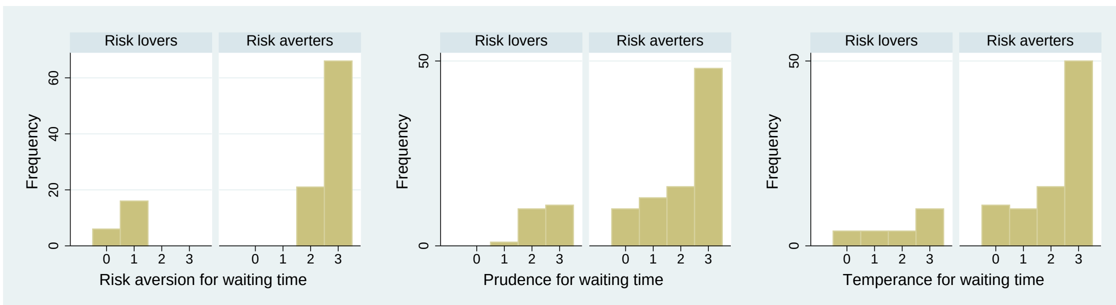
Panel (1,3) shows the distribution of correlation-averse choices for risk lovers and risk averters. In section 2.2, we derived the prediction that bivariate risk averters (bivariate risk lovers) should be correlation-averse (correlation-seeking). The histogram in panel (1,3) of Figure 7 indeed strongly suggests that risk averters are correlation-averse while risk lovers tend toward correlation-seeking. The first panel in Table IV presents choice means and tests for risk averters and risk lovers in the Intertemporal condition. Indeed, the risk avert-

Figure 6: Univariate Higher-Order risk preferences for Y for risk averters and risk lovers separately

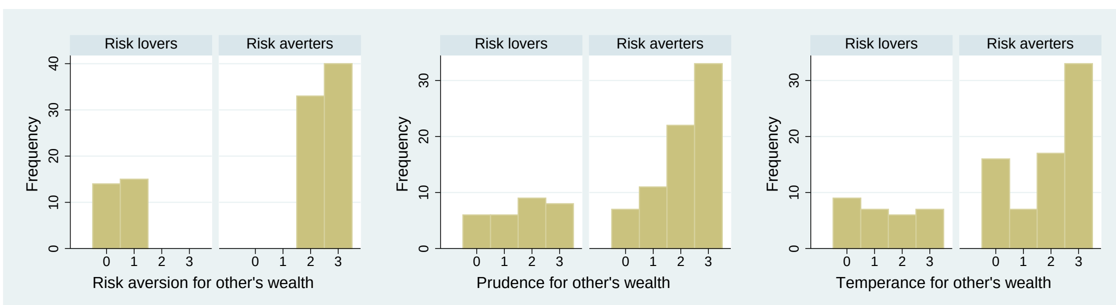
(a) Prudence and temperance for delayed monetary transfers



(b) Prudence and temperance for waiting time



(c) Prudence and temperance for other's wealth



Notes. This figure illustrates (higher-order) risk preferences for attribute for delayed monetary transfer (panel (a), condition Intertemporal), waiting time (panel (b), condition Waiting), and other's wealth (Panel (c), condition Social). The analysis is done separately for risk averters and risk lovers who made made 2 or 3 (resp. 0 or 1) choices in Task `RA-Y` in the respective condition, see the first column in each panel. Choices in Stage `PR` are shown in the second column while choices in Stage `TE` are shown in the third column.

ers are significantly correlation-averse $(2.25, p < 0.01)$ while risk lovers are insignificantly correlation-seeking.

The next four columns in the first panel of Table IV as well as the second row graphs in Figure 7 analyze bi- and uni-variate third-order risk preferences for cash today and delayed transfers. Bivariate risk averters are strongly (univariate) prudent for cash today and delayed

TABLE IV

Multivariate consistency in the three conditions

	Second Order			Third Order				Fourth Order		
	RA-X	RA-Y	X-RA	PR-X	PR-Y	X-PR-X	X-PR-Y	TE-X	TE-Y	X-TE
Condition Intertemporal: 51 risk averters and 17 risk lovers										
mean (RA)	2.57***	2.61***	2.25***	2.41***	2.39***	2.31***	2.43***	2.14***	2.08***	2.10***
mean (RL)	0.71***	0.59***	1.41	1.94*	1.88	1.94*	1.47	1.00*	0.88**	1.35
Condition Waiting: 73 risk averters and 12 risk lovers										
mean (RA)	2.75***	2.81***	2.37***	2.64***	2.29***	2.34***	2.52***	2.07***	2.22***	1.78***
mean (RL)	0.75***	0.58***	1.75	2.33***	2.17***	1.83	2.67***	1.08	1.58	1.17
Condition Social: 54 risk averters and 15 risk lovers										
mean (RA)	2.63***	2.63***	0.83***	2.65***	2.19***	1.54	1.28	2.07***	2.11***	0.93***
mean (RL)	0.67***	0.40***	1.13	2.47***	1.53	1.67	1.67	1.33	1.07	1.20

Notes. Table IV presents – for bivariate risk averters and risk lovers separately – the mean number of (higher-order and cross-) risk-averse choices in each of the 10 choice tasks (columns 2 to 11) in the Intertemporal condition (first panel), in the Waiting condition (second panel), and in the Social condition (third panel). *** (**,*) indicates significant difference from 1.5 at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests. The third row in each column shows the p-value of a Mann-Whitney-U Ranksum test that these means are the same. Two-sided t-tests (paired and unpaired, resp.) yield very similar results. By definition, risk averters (risk lovers) made 2 or 3 (0 or 1) risk-averse choices for both task RA-X and RA-Y.

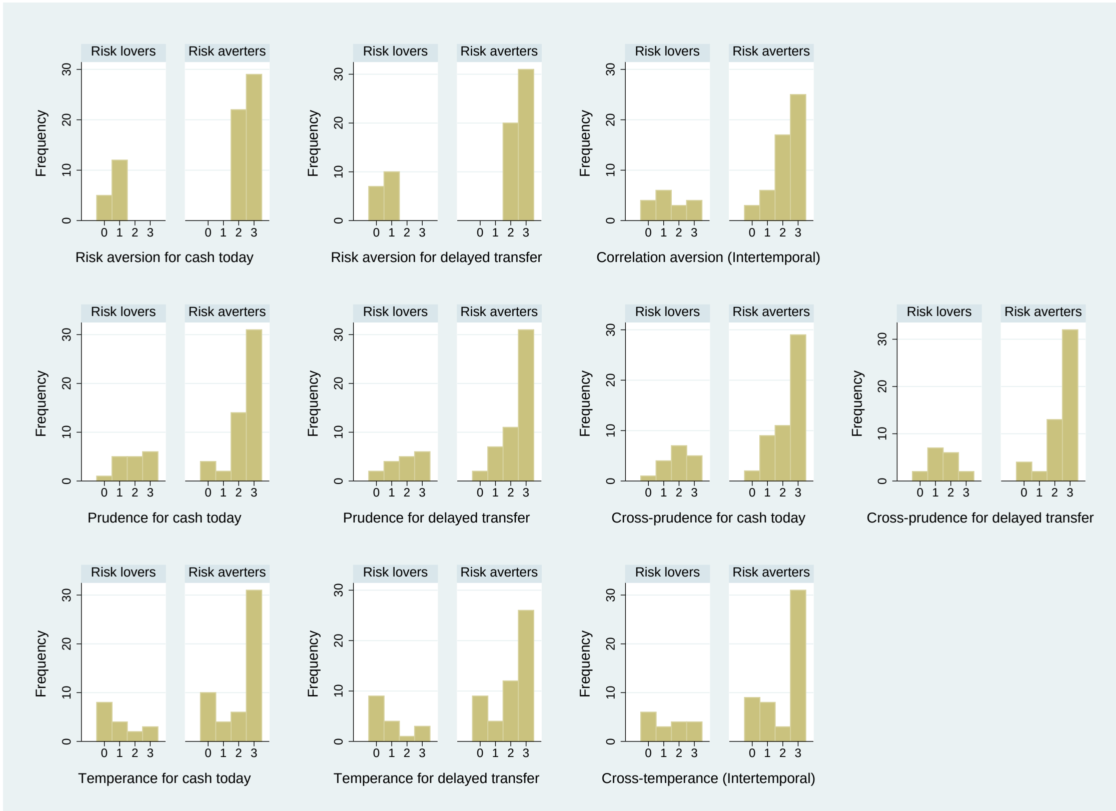
payment.[16] More interestingly, we observe that risk averters are cross-prudent for both cash today and delayed payment ($2.31, p < 0.01$ and $2.43, p < 0.01$). For risk lovers, we again find that results go into the right direction and are never at odds with the good-with-bad prediction.

The last three columns in the first panel of Table IV as well as the third row graphs in Figure 7 analyze bi- and uni-variate fourth-order risk preferences in the Intertemporal condition. In line with theory, bivariate risk averters are univariate temperate for either attribute as well as cross-temperate. Risk lovers tend to be univariate intemperate for either attribute (1.00, $p = 0.10$ for cash today and 0.88, $p = 0.05$ for transfer later) as well as non-significantly cross-intemperate.

The second and third panel of Table IV show choice means and test results for bivariate risk averters and lovers in conditions Waiting and Social. Histograms like those in Figure 7 are relegated to Appendix B. For the Waiting condition, risk averters behave just as predicted by the good-with-bad idea. They are significantly correlation-averse, univariate-prudent, cross-prudent, univariate temperate, and cross-temperate. For risk lovers we observe significant

[16] This is not surprising given the univariate analysis in the last subsection, but note the difference. There, we showed that risk aversion for cash today predicts prudence for cash today. Moreover, we showed that risk aversion for delayed payment predicts prudence for delayed payment. Here, we showed that risk averters for *both* cash today and delayed payment are prudent for cash today ($2.41, p < 0.01$) and are prudent for delayed payment ($2.39, p < 0.01$).

Figure 7: Risk preferences of multivariate risk averters and risk lovers in the Intertemporal condition



Notes. This figure shows choices in the Intertemporal condition for risk averters and risk lovers separately. The 51 risk averters (17 risk lovers) made 2 or 3 (0 or 1) risk-averse choices, for *both* cash today and money transferred in 21 days. The first (second, third) row shows the distribution of second- (third-, fourth-) order risk preferences. The first two columns show the distribution of univariate risk preferences for each attribute and the final two columns show the distribution of cross-risk attitudes for these attributes.

evidence for three out of four third-order traits, and in no case we observe a significant violation of the good-with-bad prediction. In the Social condition, on the other hand, behavior is clearly different from the good-with-bad prediction. Differences between risk lovers and risk averters are minor, neither of the two are significantly cross-prudent, and risk averters are even cross-*in*temperate. We discuss this result and put it in perspective to those for the other two conditions in the next section.

5. DISCUSSION

Our results for univariate risk preferences for current wealth corroborate the common findings in the field. That is, a majority of choices are consistent with risk aversion, prudence and temperance for wealth (Deck and Schlesinger (2010, 2014); Ebert and Wiesen (2011, 2014); Maier and Rüger (2011)), suggesting that our measurements were not affected by framing or other procedures that could have biased the obtained results in a systematic way. The evidence for temperance is weaker, which is also a stylized finding of previous research (e.g., Noussair et al. (2014)). In fact, Deck and Schlesinger (2010) find weak evidence for intemperance.

In the Social condition, the univariate risk preferences for other people's wealth are in line with the stylized pattern of risk aversion, prudence, and temperance as is often observed for own wealth. We do not observe a significant difference in the degree of risk aversion when DMs make risky choices for themselves or for somebody else. This is somewhat in line with the mixed findings in the field, with some studies (e.g., Bolton and Ockenfels (2010); Eriksen and Kvaløy (2010)) finding an increase in the degree of risk aversion for wealth of others compared to own wealth, while other studies (e.g., Chakravarty et al. (2011); Pollman et al. (2014)) find a decrease in risk aversion (i.e., an increase in risk taking) if outcomes involve monetary consequences for someone else.

The results on higher-order univariate risk preferences in the Social condition relate to Heinrich and Mayrhofer (2014) who elicit univariate prudence and temperance while varying how a choice is made (alone or while communicating with a partner) and who is affected by the decision (only the individual or the partner as well). The results cannot be compared directly as in our social condition the decision-maker decides over the other's wealth only (while her own wealth is unaffected). We thus extend the extant literature by providing evidence for prudence and temperance for other's money. Moreover, the evidence on prudence and temperance for others is weaker than for oneself, although only the latter effect is significant ($p < 0.01$).

Regarding cross-risk preferences in the Social condition, the mean response is indicative of a preference for correlation-seeking and cross-intemperance. These conditions occur in the social welfare analysis of Atkinson and Bourguignon (1982) who conclude that (p.200): "It is not easy to provide an intuitive explanation of the [cross-risk attitude derivative] conditions, but it is clear that judgments about higher-derivatives have to made if any substantial progress is to be made." Risk apportionment gives (EU-independent) interpretations of their conditions, and our results indicate that judgment should be made in favor of correlation-seeking and cross-intemperance.

correlation-seeking for own and other's wealth is further consistent with models of inequality aversion (see Fehr and Schmidt (2013) for a survey of models); DMs prefer to receive an additional unavoidable loss in the same state where the other person receives a sure loss. Given that the expected values of the lotteries in were identical within each condition, correlation-seeking and cross-intemperance are consistent with outcome fairness (i.e., equality of payoffs ex-post), but not consistent with process fairness (i.e., equality of expected payoffs ex-ante), which predicts indifference between the options (Saito (2013); Trautmann and Vieider (2012)). Moreover, significant cross-intemperance indicates a preference for ex-ante inequality aversion in the sense that individuals prefer to face a zero-mean risk in the same state where another subject faces the zero-mean risk, not knowing how either risk will turn out. Hence, our results on risk apportionment confirm the importance of outcome fairness in social settings.

Regarding risk attitudes for waiting time we confirm the finding by Abdellaoui and Kemel (forthcoming), who elicit prospect theory preferences for waiting time and observe risk aversion for waiting time. Our paper is the first to confirm a preference for prudence and temperance for waiting time. The only other paper that employs waiting time in experiments is – to best of our knowledge – Noussair and Stoop (forthcoming), who study ultimatum and other games with stakes being waiting time. Noussair and Stoop (forthcoming) make the important observation that waiting time satisfies the three precepts concerning the relationship between decisions and subject rewards that Smith (1982) proposes: non-satiation, salience, and dominance. Our paper corroborates the result that (a reduction of) waiting time serves as an effective experimental reward to be made use of in further studies.[17]

In the Intertemporal condition, we observe risk aversion, prudence and temperance for future payments. Although we do observe slightly less risk aversion for payments in the future in line with Abdellaoui et al. (2011), the difference in the degree of risk aversion is not significant. Our finding of correlation aversion between current and future wealth corroborates studies by Andersen et al. (2011) and Cheung (2015), who estimate coefficients of correlation aversion based on experimental data. Our finding of cross-prudence for current wealth is direct empirical support for Leland (1968)'s seminal precautionary saving model with non-separable utility; if future income becomes riskier, DMs are inclined to save more. The observed non-neutrality of multivariate risk preferences for current and future wealth casts doubt on the assumption that utility is separable across time, suggesting that more flexible discount functions – such as the one estimated by Andersen et al. (2011) – may be more appropriate for the structural modeling of intertemporal decision making.

Our final observations concern the consistency of risk preferences as documented by Deck and Schlesinger (2014) for univariate risk preferences for wealth. In the univariate case – for wealth and other attributes – the results are broadly consistent with the notion that decision makers consistently combine "good" with "bad" or "good" with "good". Although risk lovers are not significantly intemperate (potentially due to the low number of risk lovers in our sample), risk averters are prudent and temperate in all domains, as predicted.

A similar conclusion can be drawn with regard to multivariate consistency in conditions Intertemporal and Waiting. Risk averters are correlation-averse, cross-prudent, and cross-

[17] In fact, Wilson et al. (2014) argue that waiting may be worse than receiving electronic shocks. This is also why we used smaller amounts of waiting time than Noussair and Stoop (forthcoming) and compensated subjects in the Waiting condition well.

temperate, as predicted. For risk lovers, we observe that they consistently combine "good" with "good" for three out of four third-order traits, and in no case do we observe a significant violation of the good-with-bad prediction. To the best of our knowledge, no other study so far has investigated the consistency hypothesis for attributes other than wealth, and our study is also the first to investigate multivariate consistency.

Interestingly, in the Social condition, differences between risk lovers and risk averters is minor and neither behave as predicted by the "good-with-bad" hypothesis. We have seen in Section 4 that individuals seek equality of outcome in Task `X-RA` and some form of equality of chance in Task `X-TE`. The Social domain is thus an environment where one can meaningfully interpret higher-order cross-risk preferences, but where the good-with-bad theory – as we observed – does not apply in its current form. A possible explanation is as follows. In the Social condition – unlike in the other two conditions – whether a decrease in either attribute is perceived as good or bad may *depend* on the level of the other attribute, as in the model of Fehr and Schmidt (1999). While consistency is observed for both *absolutely* good attributes (such as money) as well as for for absolutely bad attributes (such as waiting time, see also Ebert et al. (2015)), the inability to classify an amount of other's (and maybe even own wealth) as *unconditionally* "good" or "bad" challenges the assumptions of the risk apportionment model in its current form.[18]

Finally, in Appendix A and Appendix C, we show that our results are robust to changes in the background endowment, the size of the stakes and the framing of outcomes in terms of gains and losses. This suggests that (higher-order) multivariate risk preferences are stable traits.

6. CONCLUSION

We obtain theory-free measurements of (higher-order) multivariate risk preferences in three important economic domains, *viz.*, time preferences, social preferences, and preferences for leisure time, based on the risk apportionment tasks introduced by Eeckhoudt and Schlesinger (2006) and Eeckhoudt et al. (2007). As such, for each of these domains our paper is the first to provide evidence on the prevalence of the cross-risk attitudes correlation aversion, cross-prudence and cross-temperance in the population. For current wealth and future wealth

[18]In principle, one could also dispute the assumption that other's wealth is "good" in assessing univariate tasks in the Social condition, therefore, after subjects made their risky choices but before uncertainty about experimental earnings were revealed, subjects in the Social condition were asked whether the experimenter should add €2 (for real) to the earnings of the other participant ("unconditional monotonicity"). In addition, we asked them whether the experimenter should do so depending on the difference between their earnings (from the choice tasks) and the earnings of the other participant ("conditional monotonicity"). In particular, we asked them whether they would like to increase the earnings of the other participant by €2 if the other participant earned at least €2 less than the subjects and whether they would like to so if the other participant earned more than, the same as, or at most €2 less than the subject. 95 out of 102 subjects answered two or three questions with "yes", which is why we code other's wealth as "good." Our results do not change if we drop the remaining 7 subjects from the analysis.

we find evidence that individuals are correlation-averse, cross-prudent and cross-temperate. Likewise for wealth and waiting time, we find correlation aversion at the second and higher orders. In both cases, we find tentative evidence that multivariate risk preferences are consistent with a preference for combining "good" with "bad" or "good" with "good". When the attributes concern own wealth and the wealth of somebody else, we observe correlation-seeking and cross-intemperance.

In addition, we extend the literature on higher-order univariate risk attitudes by confirming that the often-observed pattern of risk aversion, prudence and temperance extends to situations involving outcomes in terms of leisure time, future wealth, and wealth of another person. These findings have important implications for the descriptive adequacy of models and show that higher-order multivariate risk attitudes can be quantified empirically in a relatively simple, model-free, manner.

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APPENDIX A: ADDITIONAL ANALYSIS OF HIGHER-ORDER RISK PREFERENCES FOR WEALTH

A.1. *Comparison of risk preferences for wealth across conditions*

While in all conditions subjects made decisions for own, current wealth (attribute X), there were also some differences. In condition Intertemporal, X was cash today (paid right at the end of the experiment) while in conditions Waiting and Social the money was transferred to subjects' bank account on that same day. In addition, choices between conditions differed by the background endowment of attribute Y, which was a delayed monetary transfer (waiting time, other's wealth) in condition Intertemporal (Waiting, Social). Finally, stakes were different in the conditions. On average, subjects earned €9.15 in cash and had €8.83 transferred to their bank account 21 days after the experiment in the Intertemporal condition, while subjects earned €24.70 and waited 20 minutes in the Waiting condition. In the Social condition, the average earnings were € 20.90.

While it is not a primary research question to be addressed in this paper, a comparison of univariate risk preferences across conditions seems interesting. This is because all earlier studies on (higher-order) risk preferences considered some form of own current wealth (only), and thus documenting minor differences in the implementation might be valuable. Note, however, that we cannot disentangle all the effects of these differences. For example, low stakes and cash payment are both characteristic for condition Intertemporal and not faced in either of the other condition. Likewise, all background endowments are condition-specific. Table V compares risk-averse, prudent, and temperate choices across conditions, sometimes also combining some conditions.

TABLE V

Comparison of choices for own, current wealth between conditions

	RA-X			PR-X			TE-X		
	mean	mean	p	mean	mean	p	mean	mean	p
WvsS	2.24	1.92	0.03	2.53	2.45	0.48	1.94	1.91	0.88
WvsI	2.24	1.93	0.02	2.53	2.14	0.00	1.94	1.72	0.20
SvsI	1.92	1.93	0.95	2.45	2.14	0.02	1.91	1.72	0.28
W&SvsI	2.09	1.93	0.21	2.49	2.14	0.00	1.92	1.72	0.17
WvsS&I	2.24	1.93	0.01	2.53	2.30	0.03	1.94	1.82	0.41

Notes. Table V compares the mean choices over own current wealth X that we elicited in the three conditions. In condition Intertemporal (I for short), X was cash today while in conditions Waiting and Social (resp. W and S, for short) the money was transferred on the same day. In addition, choices between conditions differed by the background endowment of attribute Y, which was a delayed monetary transfer (waiting time, other's wealth) in condition I (W, S). Finally, stakes were higher in condition W to compensate for waiting time. *** (**,*) indicates significant difference from 1.5 at the 1% (5%, 10%) level according to unpaired t-tests.

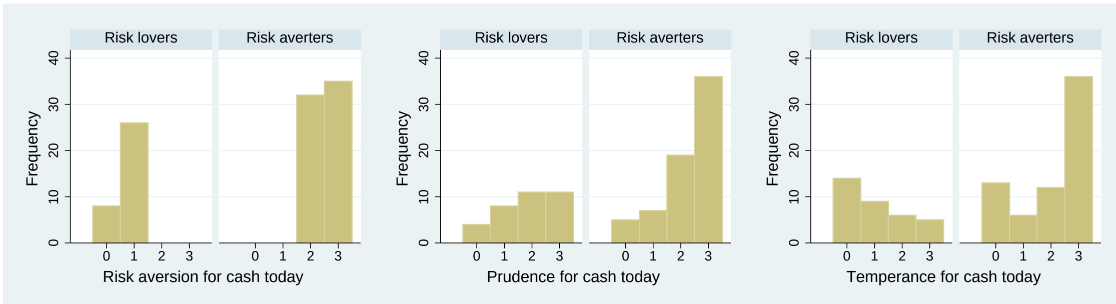
Our main hypotheses are all fulfilled for either implementation of preferences for wealth, corroborating the pervasiveness and robustness of higher-order risk preferences in this important domain. An interesting observation is that risk preferences in condition Intertemporal are a bit less pronounced. This may be due to the smaller stakes in condition Intertemporal.

A.2. *Good-with-bad analysis for own, current wealth in each of the three conditions*

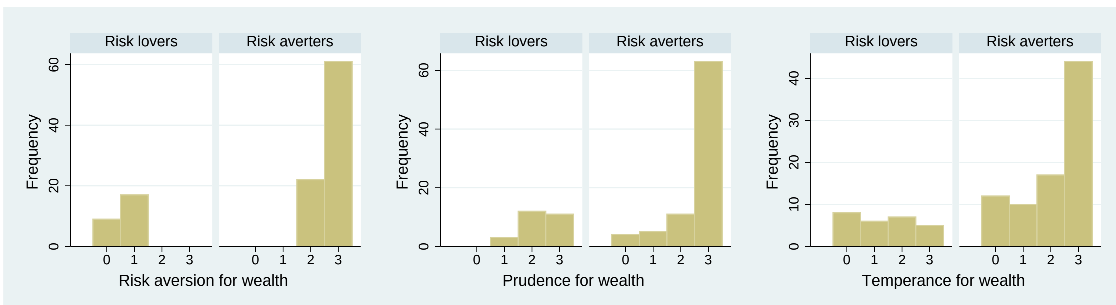
Figure 8 shows for each condition the distribution of risk preferences for own, current wealth for risk averters and risk lovers separately. Test results were discussed in the main text.

Figure 8: Univariate Higher-Order risk preferences for own, current wealth for risk averters and risk lovers separately

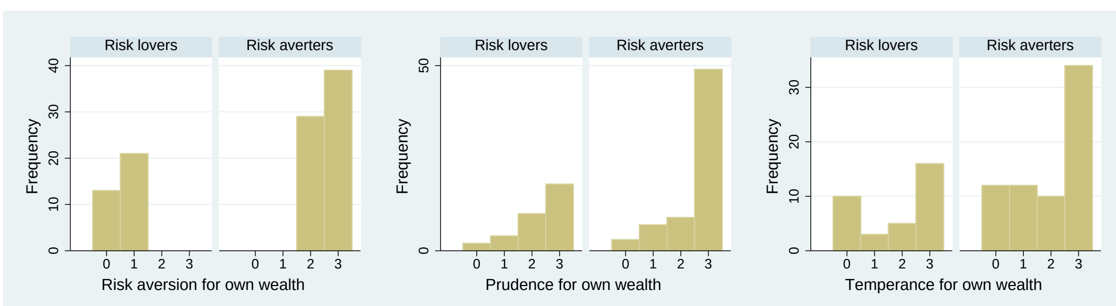
(a) Prudence and temperance for cash today (condition Intertemporal)



(b) Prudence and temperance for monetary transfer today (condition Waiting)



(c) Prudence and temperance for monetary transfer today (condition Social)



Notes. This figure illustrates (higher-order) risk preferences for cash today (panel (a), condition Intertemporal) and money transferred today (panel (b), condition Waiting as well as panel (c), condition Social). The analysis is done separately for risk averters and risk lovers who made made 2 or 3 (resp. 0 or 1) choices in Task RA-*X* in the respective condition, see the first column in each panel. Choices in Stage PR are shown in the second column while choices in Stage TE are shown in the third column.

A.3. *Combining risk preference for wealth data across conditions*

If we are willing to regard the univariate risk preference for wealth tasks as sufficiently similar within conditions, we can combine the data across conditions to establish a sample of 312 subjects and analyze their risk preferences.[19] This sample size also allows for a stricter classification of risk averters and risk lovers. Figure 9 shows the distribution of risk-averse, prudent, and temperate choices: for all subjects, for risk-lovers and risk-averters separately, and for the strict classification of risk aversion and risk lovingness. Table VI presents the test results that choices are not random. While in all cases results stay qualitatively the same, for risk lovers and "strong" risk lovers in particular, we find even more support for the good-with-bad hypothesis. This indicates that the low number of risk lovers generally challenges tests of the good-with-bad prediction, and that additional and better data rather caters to its support than against it.

TABLE VI

RISK PREFERENCES FOR WEALTH IN ALL CONDITIONS COMBINED

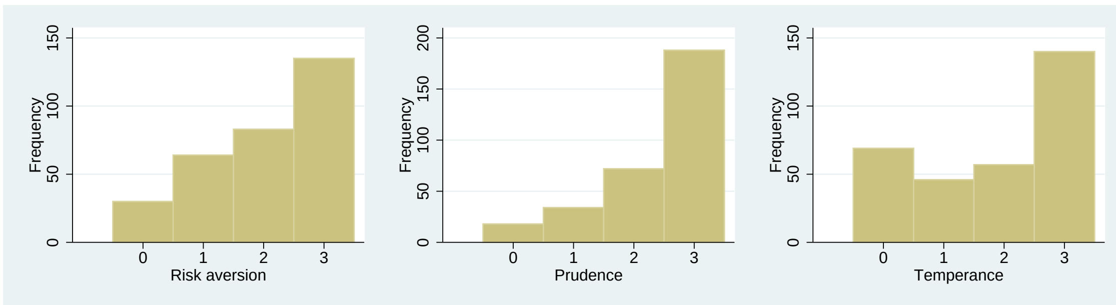
	Risk Averters			Strong Risk Averters		
	RA	PR	TE	RA	PR	TE
mean	2.04***	2.38***	1.86***	dto		
mean (RA)	2.62***	2.48***	2.06***	3.00***	2.70***	2.23***
mean (RL)	0.68***	2.14***	1.40***	0.00***	2.30***	1.17***

Notes. Table VI presents – for risk averters and risk lovers separately – the mean number of (higher-order) risk-averse choices for all three conditions. The left panel is for risk averters (risk lovers) for X who made 2 or 3 (0 or 1) risk-averse choices in Task RA-X while the right panel is for "strong" risk averters (risk lovers) for X who made 3 (0) risk-averse choices in Task RA-X. The number of risk averters (risk lovers) equals 218 (94) and the number of strong risk averters (risk lovers) equals 135 (30). *** (**,*) indicates significant difference from 1.5 at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests.

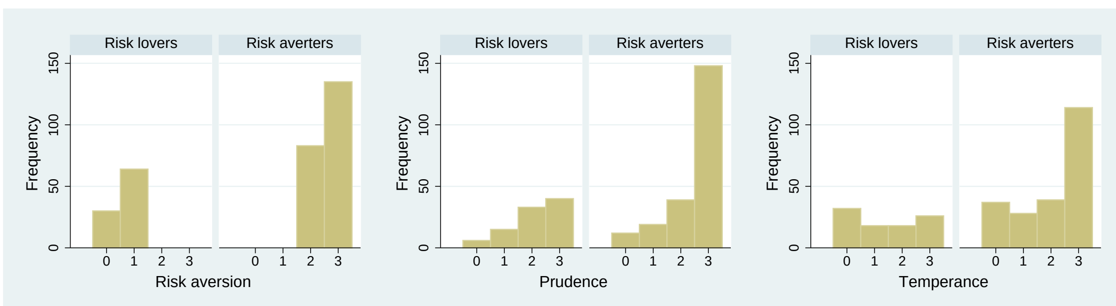
[19]The following analysis was also conducted when combining the more similar conditions Waiting and Social only. The results obtained for 211 subjects, all of who got their experimental earnings transferred to their bank account the day of the experiment, yield qualitatively the same results.

Figure 9: Univariate Higher-Order wealth preferences for subjects from all conditions

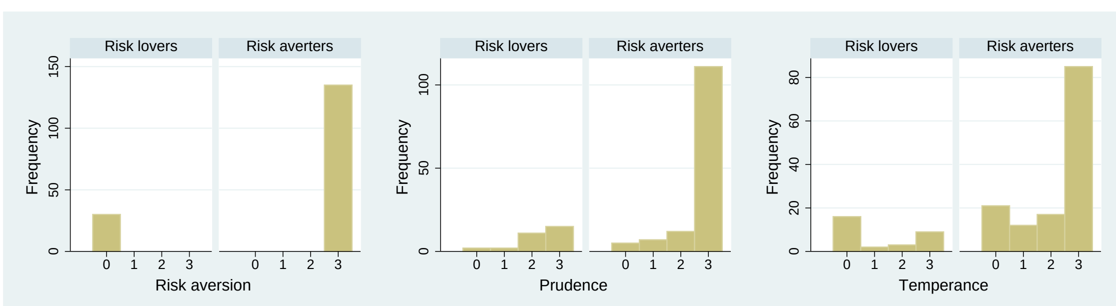
(a) All subjects



(b) Risk averters and risk lovers separately



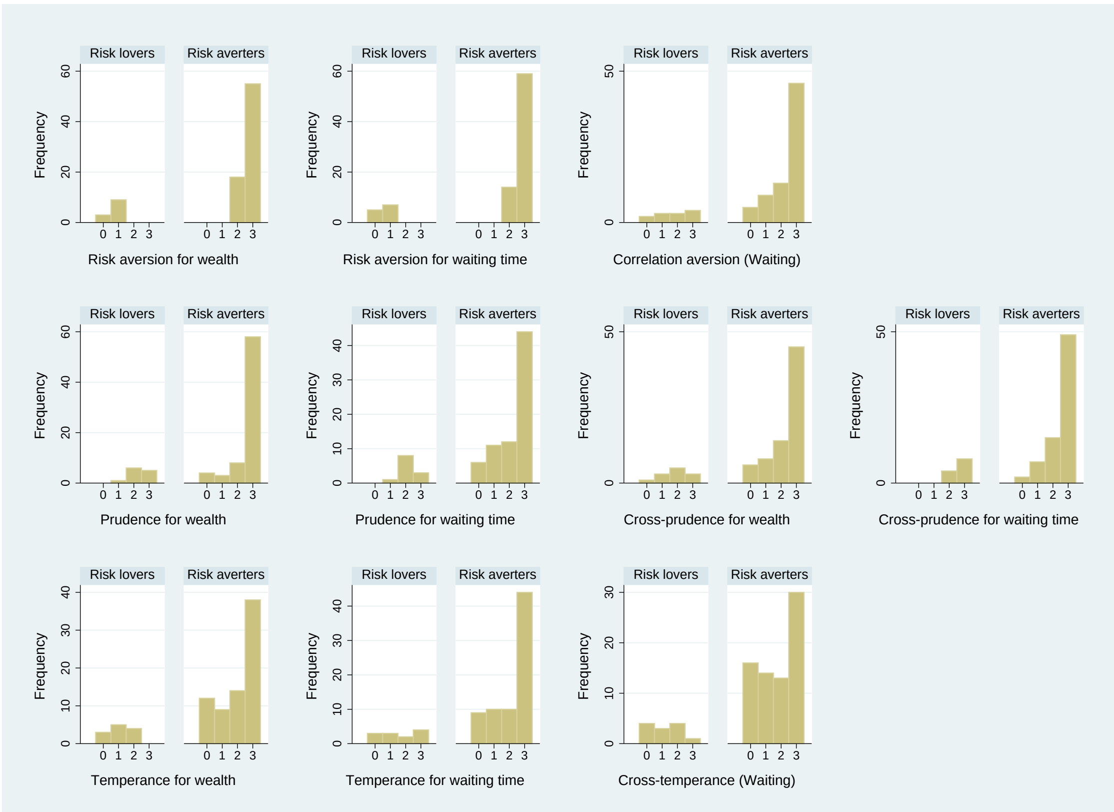
(c) Strong risk averters and risk lovers separately



Notes. Panel (a) shows the choices of the 312 subjects from all conditions in Task `RA-X` (column 1), Task `PR-X` (column 2) and Task `TE-X` (column 3). Panel (b) shows choices across conditions for 312 subjects for own, current wealth separately for 218 risk averters and 94 risk lovers who made made 2 or 3 (resp. 0 or 1) choices in Task `RA-X` (see column 1). Panel (c) shows choices for 135 "strong" risk averters and 30 "strong" risk lovers who made made 3 (resp. 0) choices in Task `RA-X` (see column 1)

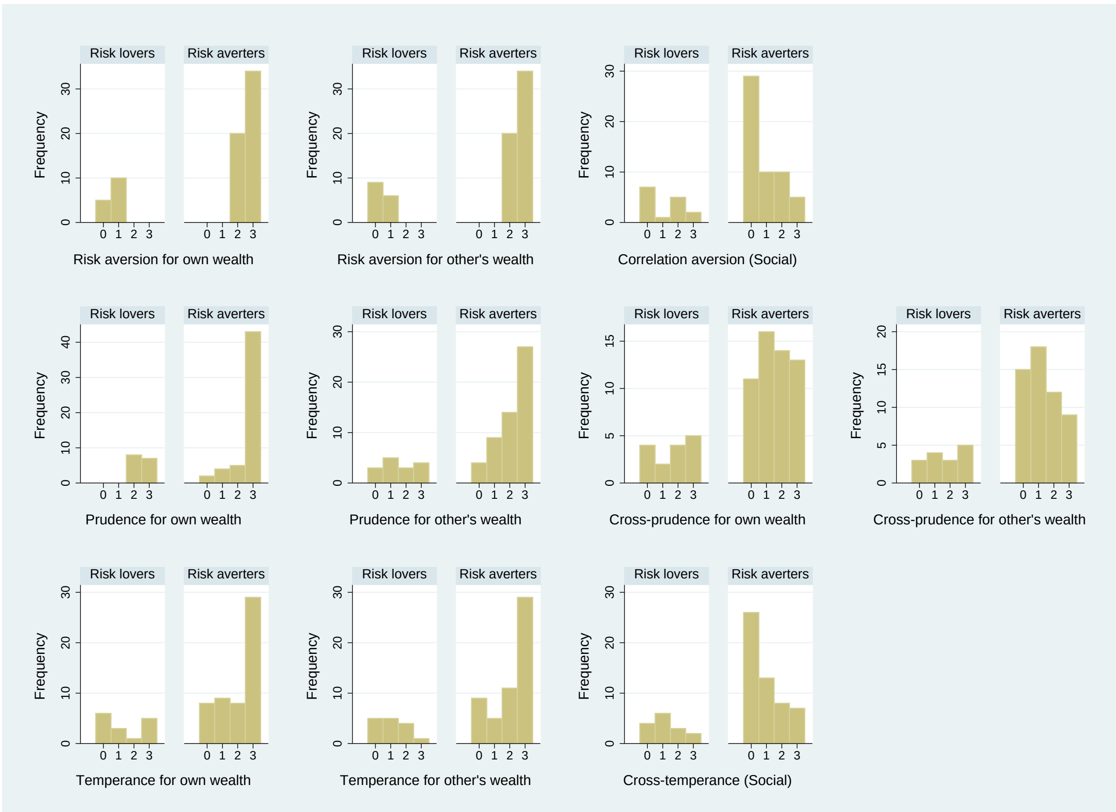
Here we present histograms for uni- and bivariate risk preferences for risk lover and risk averters separately. For the Intertemporal condition, these graphs were shown in Figure 7 in the main text. Figure 10 is for the Waiting condition while Figure 11 is for the Social condition. Recall that corresponding test results were discussed in the main text.

Figure 10: Risk preferences of multivariate risk averters and risk lovers in the Waiting condition



Notes. This figure shows choices in the Waiting condition for risk averters and risk lovers separately. The 73 risk averters (12 risk lovers) made 2 or 3 (0 or 1) risk-averse choices, for *both* transfer today and waiting time. The first (second, third) row shows the distribution of second- (third-, fourth-) order risk preferences. The first two columns show the distribution of univariate risk preferences for each attribute and the final two columns show the distribution of cross-risk attitudes for these attributes.

Figure 11: Risk preferences of multivariate risk averters and risk lovers in the Social condition



Notes. This figure shows choices in the Waiting condition for risk averters and risk lovers separately. The 54 risk averters (15 risk lovers) made 2 or 3 (0 or 1) risk-averse choices, for *both* own wealth and other's wealth. The first (second, third) row shows the distribution of second- (third-, fourth-) order risk preferences. The first two columns show the distribution of univariate risk preferences for each attribute and the final two columns show the distribution of cross-risk attitudes for these attributes.

APPENDIX C: ROBUSTNESS TOWARDS ITEMS FRAMED AS GAINS OR LOSSES

In this section, we analyze a potential impact of framing of the items to be apportioned as increases or decreases. In the main part of the paper, we framed all fixed amount items as being decreases, i.e., negative. In particular, we considered reductions in own, current wealth, reductions in future wealth, reductions in other wealth, and reductions in reduced waiting time (which are increases in waiting time). In the experiment, however, we varied this framing in four between-subject treatments, because the risk apportionment method should yield the same results irrespective of framing.[20] Indeed, this is what the subsequent analysis shows. Significant differences between treatments are rather rare for all conditions given the large amount of possible comparisons, similar to tests in a univariate setting by Ebert and Wiesen (2011, 2014).

In the Intertemporal condition, respondents faced monetary outcomes in cash or by transfer in 21 days framed in terms of gains or losses. In particular, 26 subjects were assigned to the *Sooner Gains, Later Gains* (SGLG) treatment, 23 subjects were assigned to the *Sooner Losses, Later Losses* (SLLL) treatment, 23 subjects were assigned to the *Sooner Gains, Later Losses* (SGLL) treatment, and 23 subjects were assigned to the *Sooner Losses, Later Gains* (SLLG) treatment. In the Waiting condition, subjects faced the outcomes in euros and waiting time framed in terms of gains or losses. In particular, 28 subjects were assigned to the *Wealth Gains, Time Gains* (WGTG) treatment, 27 subjects to the *Wealth Losses, Time Losses* (WLTL) treatment, 27 subjects to the *Wealth Gains, Time Losses* (WGTL) treatment, and 27 subjects to the *Wealth Losses, Time Gains* (WLTG) treatment. In the Social condition, outcomes for subjects themselves or for the other participant were frames as gains or losses. In particular, 26 subjects were assigned to the *You Gains, Other Gains* (YGOG) treatment, 24 subjects were assigned to the *You Losses, Other Losses* (YLOL) treatment, 26 subjects were assigned to the *You Gains, Other Losses* (YGOL) treatment, and 26 subjects were assigned to the *You Losses, Other Gains* (YLOG) treatment.

C.1. *Intertemporal condition*

Table VII presents the prevalence of risk apportionment preferences in the Intertemporal condition, for each treatment. The first 2 rows of the table show that even though the mean choice is significantly risk-averse for both current and future wealth overall, subjects are only significantly risk-averse for current and future wealth in the SLLG treatment. However, the observed non-significance in the other treatments might very well be explained by the limited number of observations in each treatment, as the mean number of risk-averse choices is always in the direction of a preference for risk aversion (i.e., larger than 1.5) and never in the direction of a pattern that would be indicative of risk-seeking. We do observe a strong and significant preference for prudent options for both current and future wealth, with the exception of prudence for current wealth in the SLLL treatment. Finally, we do not observe a preference for temperate options for current or future wealth in any of the treatments, which corroborates the stylized finding that temperance is less pervasive than prudence and/or risk aversion (e.g., Noussair et al. (2014)).

[20]Endowments are chosen such that the expected payoffs are the same for each treatment (see Appendix F for the exact parameters).

TABLE VII

Robustness of Risk Apportionment Preferences in the Intertemporal Condition

	ALL	SLLL	SGLL	SLLG	SGLG
Risk aversion for current wealth	1.93 [2]***,o	1.78 [2]	1.88 [2]*	2.15 [2]***	1.88 [2]*
Risk aversion for future wealth	1.89 [2]***,o	1.83 [2]	1.88 [2]*	2.04 [2]***	1.81 [2]
Prudence for current wealth	2.14 [2]***,o	1.91 [2]	2.23 [2]***	2.15 [2]***	2.23 [2.5]***
Prudence for future wealth	2.18 [3]***,o	2.00 [2]**	2.23 [3]***	2.31 [2.5]***	2.15 [3]***
Temperance for current wealth	1.72 [2]*,o	1.35 [1]a	1.62 [2]	2.12 [2.5]***	1.77 [2]
Temperance for future wealth	1.66 [2]o	1.22 [1]	1.85 [2]	1.88 [2]	1.65 [2]
Correlation aversion	1.92 [2]***,o	2.17 [3]***,b	1.96 [2]**	1.96 [2]**	1.62 [2]
Cross-prudence for current wealth	2.12 [2]***,o	2.04 [2]**	2.27 [2.5]***	2.08 [2]***	2.08 [2]**
Cross-prudence for future wealth	2.11 [2]***,o	1.96 [2]**	2.31 [3]***	2.00 [2.5]**	2.15 [2.5]***
Cross-temperance	1.84 [2]***,o	1.30 [1]c,d	1.65 [2]	2.31 [3]***	2.04 [3]**
N	101	23	23	23	26

Notes. Entries are means [medians]. *** (**,*) indicates significantly different from random choice (i.e., from 1.5) at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests; [a] SLLL treatment significantly different from SLLG treatment at the 5% significance level, Mann-Whitney test; [b] SLLL treatment significantly different from SGLG treatment at the 5% significance level, Mann-Whitney test; [c] SLLL treatment significantly different from SLLG treatment at the 1% significance level, Mann-Whitney test; [d] SLLL treatment significantly different from SGLG treatment at the 5% significance level, Mann-Whitney test; [o]distribution of choices is significantly different from the distribution of choices that would be observed if subjects chose randomly at the 1% significance level, Chi^2 test.

Regarding the cross-risk attitudes, rows 7-10 show that a significant majority of decisions are consistent with (i) correlation aversion, (ii) cross-prudence for current wealth, and (iii) cross-prudence for future wealth, although our measurement of correlation aversion is not significantly different from 1.5 in the SGLG treatment. The evidence regarding cross-temperance for current and future wealth is more mixed. In the SLLG and SGLG treatment, the preference to disaggregate independent zero-mean risks of current and future wealth is significantly stronger than would be observed if subjects chose randomly, but this is not the case in the SLLL and SGLL treatments. Thus, it appears that the cross-prudent preference is more pronounced than the preference for cross-temperance, which extends to common finding to multivariate risk preferences.

TABLE VIII

Robustness of Risk Apportionment Preferences in the Waiting Condition

	ALL	WGTG	WGTL	WLTG	WLTL
Risk aversion for wealth	2.24 [3]***,o	2.11 [2]***	2.37 [3]***	2.37 [3]***	2.11 [3]***
Risk aversion for leisure time	2.35 [3]***,o	2.21 [3]***	2.56 [3]***	2.44 [3]***	2.19 [2]***
Prudence for wealth	2.53 [3]***,o	2.50 [3]***	2.70 [3]***	2.48 [3]***	2.44 [3]***
Prudence for leisure time	2.23 [3]***,o	2.07 [2]***	2.48 [3]***	1.89 [2]b	2.48 [3]***
Temperance for wealth	1.94 [2]***,o	1.75 [2]	1.96 [2]**	2.19 [3]***	1.85 [2]
Temperance for leisure time	2.15 [3]***,o	1.96 [2]**,a	1.96 [3]	2.11 [3]***	2.56 [3]***
Correlation aversion	2.17 [3]***,o	1.96 [2]**	2.30 [3]	2.15 [3]***	2.30 [3]***
Cross-prudence for wealth	2.27 [3]***,o	2.21 [2]***	2.67 [3]***,c	1.89 [2]	2.30 [3]***
Cross-prudence for leisure time	2.45 [3]***,o	2.46 [3]***	2.48 [3]***	2.48 [3]***	2.37 [3]***
Cross-temperance	1.64 [2]o	1.39 [1]	2.04 [2]**,c	1.26 [1]	1.89 [2]
N	109	28	27	27	27

Notes. Entries are means [medians]. *** (**,*) indicates significantly different from random choice (i.e., from 1.5) at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests; [a] WGTG treatment significantly different from WLTL treatment at the 5% significance level, Mann-Whitney test; [b] WLTG treatment significantly different from WLTG and WLTL treatment at the 5% significance level, Mann-Whitney test; [c] WGTL treatment significantly different from WGTG and WLTG treatment at the 5% significance level, Mann-Whitney test; [o]distribution of choices is significantly different from the distribution of choices that would be observed if subjects chose randomly at the 1% significance level, Chi^2 test.

C.2. *Waiting condition*

Table VIII presents the prevalence of risk apportionment preferences in the Waiting condition, for each treatment. The first two rows of the table show that a significant majority of decisions are consistent with risk aversion for wealth and leisure time in each treatment. It also shows evidence for prudence for leisure time and wealth, although this preference is not statistically significant for leisure time in the WLTG treatment. Our findings for the prevalence of temperance appear to be less robust. Overall, we do find evidence for temperance for both wealth and leisure time, but, as Table VIII shows, although the mean choice pattern is in the direction of temperance, it is not significantly so for wealth in the WGTG and WLTL treatments and for leisure time in the WGTL treatment, supporting the finding in the field that temperance is less pervasive than prudence (Deck and Schlesinger, 2014). Interestingly, prudence appears to be stronger when lotteries involve monetary outcomes than when lotteries involve outcomes in leisure time (Wilcoxon signed-rank test, $p < 0.01$). Table VIII also shows that we observe a preference for the correlation-averse- and cross-prudent options. That is, the majority of choices is consistent with correlation aversion and cross-prudence for wealth and leisure time, although our measure of cross-prudence for wealth and leisure time is not significantly different from the prediction of random choice in the WLTG treatment. However, a consistent preference for cross-temperance is not observed in our sample, with the exception of our measure of cross-temperance in the WGTL treatment. More specifically, in the WGTL treatment, subjects are more cross-temperate and more cross-prudent for wealth and leisure time than in the WGTG and WLTG treatments. Our measure of cross-prudence for wealth is not statistically different from our measure of cross-prudence for leisure time (Wilcoxon signed-rank test, p=0.12).

C.3. *Social condition*

Table IX presents the prevalence of risk apportionment preferences in the Social condition, for each treatment. The first two rows of the table show that a majority of decisions are consistent with risk aversion for outcomes accruing to oneself, although a significant preference for risk aversion is not observed in the YGOL and the YLOG treatment. Thus, when the attributes (you, other) were in different domains (gains, losses), subjects became less risk-averse for themselves. We do find evidence for prudence for oneself and for someone else, although the prudence preference for someone else is not significantly different from the preference that would be observed if subjects chose randomly in the YGOL and the YLOG treatment. Notice that a lack of significance in these treatments is potentially the result of the limited amount of observations in each treatment; the median choice in all the treatments is in line with a preference for prudence. Finally, we obtain some - albeit weak - evidence for a temperance preference in the Social condition. Even though the preference for the temperate lottery is only significantly different from random choice in the YLOG treatment if the lottery involved outcomes for oneself – and in the YGOG treatment if the lottery involved outcome for the other participant – overall the preference for temperance for oneself and for the someone else is different from 1.5. Also, the modal and mean choice are in line with a preference for temperance for both attributes. Table IX also shows that respondents in the Social condition are correlation-seeking and cross-intemperate in all treatments.

TABLE IX

Robustness of Risk Apportionment Preferences in the Social Condition

	ALL	YGOG	YGOL	YLOG	YLOL
Risk aversion for self	1.92 [2]***,o	2.12 [2]***,a	1.46 [1.5]b	1.92 [2]	2.21 [2]***
Risk aversion for other	1.97 [2]***,o	1.92 [2]**	2.00 [2]***	1.85 [2]	2.13 [2.5]***
Prudence for self	2.45 [3]***,o	2.62 [3]***	2.42 [3]***	2.19 [2.5]***	2.58 [3]***
Prudence for other	1.98 [2]***,o	2.19 [2]***	1.77 [2]c	1.62 [2]d	2.38 [3]***
Temperance for self	1.91 [2]***,o	1.92 [3]	1.73 [2.5]	2.04 [2]**	1.96 [2.5]
Temperance for other	1.76 [2]**,o	2.00 [2]**	1.62 [2]	1.73 [2]	1.71 [2]
Correlation aversion	0.85 [1]***,o	0.69 [0]***	0.88 [1]***	0.92 [1]***	0.92 [1]**
Cross-prudence for self	1.58 [2]o	1.85 [2]	1.58 [1.5]	1.46 [1.5]	1.42 [1]
Cross-prudence for other	1.38 [1]o	1.58 [1.5]	1.42 [1]	1.15 [1]	1.38 [1]
Cross-temperance	0.91 [0]***,o	0.88 [1]***	0.85 [0.5]***	1.00 [0.5]**	0.92 [0]**
N	102	26	26	26	24

Notes. Entries are means [medians]. *** (**,*) indicates significantly different from random choice (i.e., from 1.5) at the 1% (5%, 10%) level according to Wilcoxon-signed rank tests; [a] YGOG treatment significantly different from YLOG treatment at the 5% significance level, Mann-Whitney test; [b] YGOL treatment significantly different from YLOL treatment at the 1% significance level, Mann-Whitney test; [c] YGOL treatment significantly different from YLOL treatment at the 5% significance level, Mann-Whitney test; [d] YLOG treatment significantly different from YLOL treatment at the 5% significance level, Mann-Whitney test; [o]distribution of choices is significantly different from the distribution of choices that would be observed if subjects chose randomly at the 1% significance level, Chi^2 test.

APPENDIX D: EXPERIMENTAL INSTRUCTIONS SOCIAL CONDITION

D.1. *General instructions*

Welcome to this experiment. During the experiment:

- please no talking
- turn off your cell phone
- and raise your hand if anything is unclear, to be helped in private

In this experiment, you are asked to make 33 choices. The first 32 choices amount to making a choice between two options yielding amounts of money for you and for another participant of this experiment. The final choice is a bit different, and will be explained at the end of the experiment. For now, it is important to know that 1 of the 32 choices will be randomly selected at the end of the experiment. For this purpose, the experimenter will now ask one of you to select an envelope from a pile of sealed envelopes containing cards with number 1-32 on them. In particular, the experimenter will ask one of you to draw an envelope from the pile and sign it, so that you know that the envelope that will be opened at the end of the experiment is the selected envelope.

(Experimenter asked one participant to draw an envelope)

At the start of the experiment, the computer will randomly match you with one other participant of this experiment. In the following, we refer to this participant as "the participant matched to you" or, simply, "the other participant." You will not learn the identity of the participant matched to you; neither will the participant matched to you learn your identity. Then, with equal (50/50) chance the computer will select either your choice or the choice of the other participant with equal (50/50) chance. The outcome of this choice will be paid for real to you and the other participant. In particular, if the computer selects your choice, both you and the participant matched to you will be paid the outcome of your choice. On the other hand, if the computer selects the choice of the participant matched to you, both you and the participant matched to you will be paid the outcome of the choice made by the other participant. Thus your earnings – and the earnings of the other participant – are either determined by your choice or the choice made by the other participant. On top of these earnings, you and the other participant will be paid the outcome of the final choice (choice 33) plus a show-up fee of €4. Thus, your earnings are determined as follows: Outcome of 1 of the first 32 choices (either your choice or the choice of the other participant) + Outcome of the final choice + show up fee of €4. The experimenter will now hand out the instructions for the first 9 choices and read these instructions aloud. When everybody has completed the first 9 choices, additional instructions will be handed out. Note that we will wait for everybody to make each choice before proceeding to the next; you might have to wait before a new choice appears on your screen.

D.2. *Instructions risk/correlation aversion*

The following 9 choices all concern two options, labeled LEFT and RIGHT. The options yield outcomes for you and for the participant matched to you, depending on the roll of a standard six-sided die. Thus, the probability that the roll of the die is even (or odd) is equal to 50%. The die will be rolled at the end of the experiment. An example choice is given below. This example is not a choice that you will actually encounter during the experiment, but merely illustrates the format.

LEFT			
roll is even (50%)	you +10 €	you +5 €	other +10 €
roll is odd (50%)	you +10 €	you -7 €	other +10 €

RIGHT				
roll is even (50%)	you +10 €	you +5 €	you -7 €	other +10 €
roll is odd (50%)	you +10 €			other +10 €

As you can see, both options yield outcomes for you (listed under "you") and for the participant matched to you (listed under "other") depending on whether the roll of the six-sided die is odd (50%) or even (50%). In particular, in the example, if the roll of the die is even, LEFT yields €15 (€10 + €5) for you and €10 for the other participant. If the roll of the die is odd, LEFT yields €3 (€10 - €7) for you and €10 for the other participant. RIGHT yields €8 (€10 + €5 - €7) for you and €10 for the other participant if the roll is even, and yields €10 for you and €10 for the other participant if the die is odd. Note that the choice between LEFT and RIGHT amounts to where you want to have the outcome -€7 for you: if the roll of the die is odd (LEFT) or even (RIGHT). Also note that in the example choice, the expected outcomes for you and the other are identical for both options. However, the potential outcomes, and the chances to get these outcomes, differ between the options. This will be the case for the next 9 choices that you will encounter. As explained, if one of the next 9 choices is selected to be for real, either the option that you have chosen in that choice will determine your earnings (with you getting the payments listed under "you" and the other participant getting the payment listed under "other" in that option) or the option that the other participant has chosen in that choice will determine your earnings (with you getting the payments listed under "other" and the other participant getting the payment listed under "you" in that option). For example, suppose that the choice depicted above is selected to be paid for real, the roll is odd, you have chosen LEFT and the option chosen by you is selected to be paid for real. Then, you will get €3 and the participant matched to you will get €10. As another example, suppose that the choice depicted above is selected to be paid for real, the roll is even, the other participant has chosen RIGHT and the option chosen by the other participant is selected to be paid for real. Then, you will get €10 and the participant matched to you will get €8. In the next 9 choices, you are asked to choose between similar options. Please raise your hand if you need further explanation from the experimenter. If there are no questions, the experimenter will soon start the program.

D.3. *Instructions (cross-)prudence*

The following 12 choices again all concern two options, labeled LEFT and RIGHT. The options yield outcomes for you and for the participant matched to you, depending on the roll of a standard six-sided die and on the color of a card drawn at random from a deck of standard playing cards containing 5 black and 5 red cards. Thus, the probability that the roll of the die is even and the probability that a red card is drawn from the deck are both equal to 50%. The die and the card will be rolled/drawn at the end of the experiment. An example choice is given below. This example is not a choice that you will actually encounter during the experiment, but merely illustrates the format.

LEFT			
roll is even (50%)	you +10 €	you -5 €	other +10 €
roll is odd (50%)	you +10 €	you card is red (50%): +5 € card is black (50%): -5 €	other +10 €

RIGHT				
roll is even (50%)	you +10 €	you -5 €	you card is red (50%): +5 € card is black (50%): -5 €	other +10 €
roll is odd (50%)	you +10 €			other +10 €

As you can see, both options yield outcomes for you - listed under “you” - and for the participant matched to you - listed under “other” - depending on whether the roll of the six-sided die is odd (50%) or even (50%), and on whether the card drawn from the deck is red (50%) or black (50%). In particular, in the example, if the roll of the die is even, LEFT yields €5 (€10 - €5) for you and €10 for the other participant. If the roll is odd and the card is red, LEFT yields €15 (€10 + €5) for you and €10 for the other participant. If the roll is odd and the card is black, LEFT yields €5 (€10 - €5) for you and €10 for the other participant. RIGHT yields €10 (€10 - €5 + €5) for you and €10 for the other participant if the roll is even and the card is red. If the roll is even and the card is black, RIGHT yields €0 (€10 - €5 - €5) for you and €10 for the other participant. Finally, RIGHT yields €10 for you and €10 for the other participant if the roll is odd. Note that the choice between LEFT and RIGHT amounts to where you want to have the outcome depending on the draw of the card: if the roll of the die is odd (LEFT) or even (RIGHT). Also note that in the example choice, the expected outcomes for you and the other are identical for both options. However, the potential outcomes, and the chances to get these outcomes, differ between the options. This will be the case for the next 12 choices that you will encounter. As explained, if one of the next 12 choices is selected to be for real, either the option that you have chosen in that choice will determine your earnings (with you getting the payments listed under “you” and the other participant getting the payment listed under “other” in that option) or the option that the other participant has chosen in that choice will determine your earnings (with you getting the payments listed under “other” and the other participant getting the payment listed under “you” in that option). For example, suppose that the choice depicted above is selected to be paid for real, the roll is odd and the card is red, you have chosen LEFT and the option chosen by you is selected to be paid for real. Then, you will get €15 and the participant matched to you will get €10. In the next 12 choices, you are asked to choose between similar options. Please raise your hand if you need further explanation from the experimenter. If there are no questions, the experimenter will soon start the program.

D.4. *Instructions (cross-)temperance*

The following 9 choices all concern two options, labeled LEFT and RIGHT. The options yield outcomes for you and for the participant matched to you, depending on the roll of a standard six-sided die, the color of a card drawn at random from a deck of standard playing cards containing 5 black and 5 red cards, and the color of a ball drawn at random from a bag of balls containing 5 white and 5 yellow balls. Thus, the probability that the roll of the die is even, the probability that a red card is drawn from the deck, and the probability that a white ball is drawn from the bag are all equal to 50%. The die, the card and the ball will be rolled/drawn at the end of the experiment. An example choice is given below. This example is not a choice that you will actually encounter during the experiment, but merely illustrates the format.

LEFT			
	you	you	other
roll is even (50%)	+10 €	card is red (50%): +5 € card is black (50%): -5 €	+10 €
roll is odd (50%)	+10 €	ball is white (50%): +5 € ball is yellow (50%): -5 €	+10 €

RIGHT				
	you	you	you	other
roll is even (50%)	+10 €	card is red (50%): +5 € card is black (50%): -5 €	ball is white (50%): +5 € ball is yellow (50%): -5 €	+10 €
roll is odd (50%)	+10 €			+10 €

As you can see, both options yield outcomes for you - listed under “you” - and for the participant matched to you - listed under “other” - depending on whether the roll of the six-sided die is even (50%) or odd (50%), whether the card drawn from the deck is red (50%) or black (50%), and on whether the ball drawn from the bag is white (50%) or yellow (50%). In particular, in the example, if the roll of the die is even and the card is red, LEFT yields €15 (€10 + €5) for you and €10 for the other participant. If the roll of the die is even and the card is black, LEFT yields €5 (€10 - €5) for you and €10 for the other participant. On the other hand, if the roll of the die is odd and the ball is white, LEFT yields €15 (€10 + €5) for you and €10 for the other participant. Finally, if the roll of the die is odd and the ball is yellow, LEFT yields €5 (€10 - €5) for you and €10 for the other participant. Similarly, in the example, RIGHT yields €20 (€10 + €5 + €5) for you and €10 for the other participant if the roll is even, the card is red and the ball is white. RIGHT yields €10 (€10 + €5 - €5) for you and €10 for the other participant if the roll is even the card is black and the ball is white, or if the roll is even the card is red and the ball is yellow. If the roll is even, the card is black and the ball is yellow, RIGHT yields €0 (€10 - €5 - €5) for you and €10 for the other participant. Finally, RIGHT yields €10 for you and €10 for the other participant if the roll is odd. Note that the choice between LEFT and RIGHT amounts to where you want to have the outcome depending on the draw of the ball: if the roll of the die is odd (LEFT) or even (RIGHT). Also note that in the example choice, the expected outcomes for you and the other are identical for both options. However, the potential outcomes, and the chances to get these outcomes, differ between the options. This will be the case for the next 9 choices that you will encounter. As explained, if one of the next 12 choices is selected to be for real, either the option that you have chosen in that choice will determine your earnings (with you getting the payments listed under "you" and the other participant getting the payment listed under "other" in that option) or the option that the other participant has chosen in that choice will determine your earnings (with you getting the payments listed under "other" and the other participant getting the payment listed under "you" in that option). In the next 9 choices, you are asked to choose between similar options. Please raise your hand if you need further explanation from the experimenter. If there are no questions, the experimenter will soon start the program.

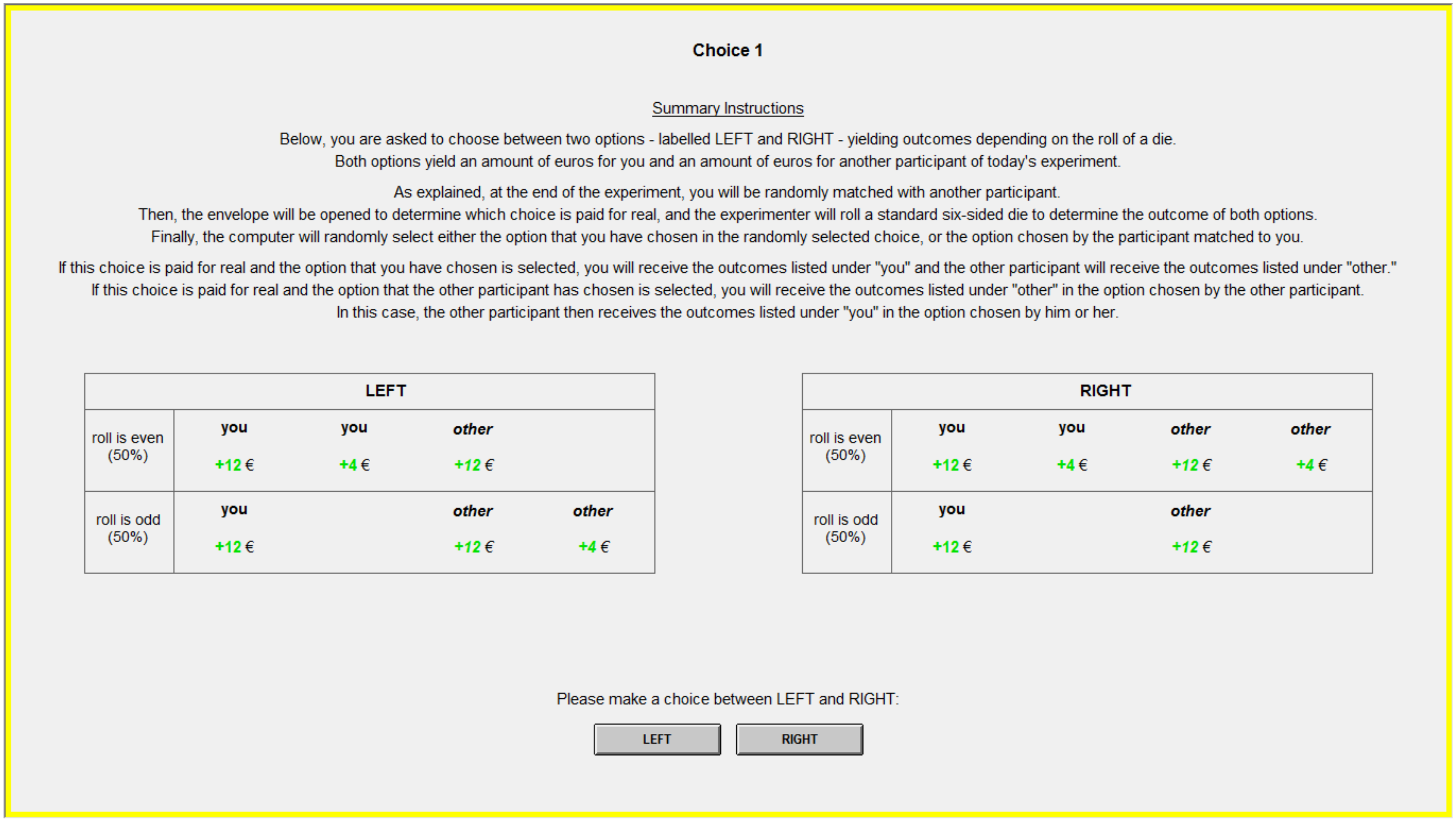
APPENDIX E: A SCREENSHOT FROM THE SOCIAL CONDITION

Figure 12 shows a full screenshot of a decision screen faced by subjects in the Social conditions. The experiment was programmed in z-tree (Fischbacher, 2007).

APPENDIX F: PARAMETERS OF THE LOTTERIES EMPLOYED IN THE EXPERIMENT

Tables X, XI, and XII respectively show the endowments and items used to construct the risk apportionment lotteries employed in conditions Intertemporal, Waiting, and Social. For each condition, there were four treatments in which items for either attribute were framed as gains or losses.

Figure 12: Example of a decision screen



Notes. This figure illustrates shows a screenshot of a decision screen faced by subjects in the Social conditions. Summary instructions are presented above the risk apportionment lotteries. This example is for a correlation aversion task when items are framed as gains (treatment *You-loss-Other-loss*). The subject can indicate correlation aversion (correlation-seeking) by clicking the LEFT-button (the RIGHT-button) at the bottom of screen. Recall that LEFT and RIGHT as well as up- and down state in each lottery were randomized.

Table X: Lotteries Intertemporal Condition

Trait	SGLG				SGLL				SLLG				SLLL			
	x	y	I_1	I_2	x	y	I_1	I_2	x	y	I_1	I_2	x	y	I_1	I_1
RA − X_1	+€9	+€7	+€2	+€3	+€9	+€7	+€2	+€3	+€19	+€7	-€2	-€3	+€19	++€7	-€2	-€3
RA − X_2	+€10	+€7	+€3	+€1	+€10	+€7	+€3	+€1	+€18	+€7	-€3	-€1	+€18	+€7	-€3	-€1
RA − X_3	+€9	+€7	+€1	+€4	+€9	+€7	+€1	+€4	+€19	+€7	-€1	-€4	+€19	+€7	-€1	-€4
RA − Y_1	+€7	+€4.5	+€2	+€3	+€7	+€9.5	-€2	-€3	+€7	+€4.5	+€2	+€3	+€7	+€9.5	-€2	-€3
RA − Y_2	+€7	+€5	+€3	+€1	+€7	+€9	-€3	-€1	+€7	+€5	+€3	+€1	+€7	+€9	-€3	-€1
RA − Y_3	+€7	+€4.5	+€1	+€4	+€7	+€4.75	-€1	-€4	+€7	+€4.5	+€1	+€4	+€7	+€4.75	-€1	-€4
X − RA_1	+€12	+€6	+€2	+€2	+€12	+€8	+€2	-€2	+€16	+€6	-€2	+€2	+€16	+€8	-€2	-€2
X − RA_2	+€11	+€5.5	+€3	+€3	+€11	+€8.5	+€3	-€3	+€17	+€5.5	-€3	+€3	+€17	+€8.5	-€3	-€3
X − RA_3	+€13	+€6.5	+€1	+€1	+€13	+€7.5	+€1	-€1	+€15	+€6.5	-€1	+€1	+€15	+€7.5	-€1	-€1
PR − X_1	+€12	+€7	+€2	±€2.5	+€12	+€7	+€2	±€2.5	+€16	+€7	-€2	±€2.5	+€16	+€7	-€2	±€2.5
PR − X_2	+€11	+€7	+€3	±€2	+€11	+€7	+€3	±€2	+€17	+€7	-€3	±€2	+€17	+€7	-€3	±€2
PR − X_3	+€13	+€7	+€1	±€3.5	+€13	+€7	+€1	±€3.5	+€15	+€7	-€1	±€3.5	+€15	+€7	-€1	±€3.5
PR − Y_1	+€7	+€6	+€2	±€2.5	+€7	+€8	-€2	±€2.5	+€7	+€6	+€2	±€2.5	+€7	+€8	-€2	±€2.5
PR − Y_2	+€7	+€5.5	+€3	±€2	+€7	+€8.5	-€3	±€2	+€7	+€5.5	+€3	±€2	+€7	+€8.5	-€3	±€2
PR − Y_3	+€7	+€6.5	+€1	±€3.5	+€7	+€7.5	-€1	±€3.5	+€7	+€6.5	+€1	±€3.5	+€7	+€7.5	-€1	±€3.5
X − PR − X_1	+€12	+€7	+€2	±€2.5	+€12	+€7	+€2	±€2.5	+€16	+€7	-€2	±€2.5	+€16	+€7	-€2	±€2.5
X − PR − X_2	+€11	+€7	+€3	±€2	+€11	+€7	+€3	±€2	+€17	+€7	-€3	±€2	+€17	+€7	-€3	±€2
X − PR − X_3	+€13	+€7	+€1	±€3.5	+€13	+€7	+€1	±€3.5	+€15	+€7	-€1	±€3.5	+€15	+€7	-€1	±€3.5
X − PR − Y_1	+€7	+€6	±€2.5	+€2	+€7	+€8	±€2.5	-€2	+€7	+€6	±€2.5	+€2	+€7	+€8	±€2.5	-€2
X − PR − Y_2	+€7	+€5.5	±€2	+€3	+€7	+€8.5	±€2	-€3	+€7	+€5.5	±€2	+€3	+€7	+€8.5	±€2	-€3
X − PR − Y_3	+€7	+€6.5	±€3.5	+€1	+€7	+€7.5	±€3.5	-€1	+€7	+€6.5	±€3.5	+€1	+€7	+€7.5	±€3.5	-€1
TE − X_1	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5
TE − X_2	+€7	+€7	±€2	±€3	+€7	+€7	±€2	±€3	+€7	+€7	±€2	±€3	+€7	+€7	±€2	±€3
TE − X_3	+€7	+€7	±€3.5	±€1.5	+€7	+€7	±€3.5	±€1.5	+€7	+€7	±€3.5	±€1.5	+€7	+€7	±€3.5	±€1.5
TE − Y_1	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5
TE − Y_2	+€7	+€7	±€2	±€3	+€7	+€7	±€2	±€3	+€7	+€7	±€2	±€3	+€7	+€7	±€2	±€3
TE − Y_3	+€7	+€7	±€3.5	±€1.5	+€7	+€7	±€3.5	±€1.5	+€7	+€7	±€3.5	±€1.5	+€7	+€7	±€3.5	±€1.5
X − TE_1	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5	+€7	+€7	±€2.5	±€2.5
X − TE_2	+€7	+€7	±€2	±€2	+€7	+€7	±€2	±€2	+€7	+€7	±€2	±€2	+€7	+€7	±€2	±€2
X − TE_3	+€7	+€7	±€3.5	±€3.5	+€7	+€7	±€3.5	±€3.5	+€7	+€7	±€3.5	±€3.5	+€7	+€7	±€3.5	±€3.5

Notes. This table describes the parameters of the lotteries that were used in each of the four treatments of the Intertemporal condition. RA (PR, TE) refers to risk aversion (prudence, temperance), attribute X is wealth in cash today, attribute Y is wealth transferred to the bank account in 21 days, and an "X" before the entry indicates a cross-trait. Respondents were asked to choose between the lottery $A = [x + y + I_1 + 0; x + y + I_2 + 0]$ and $B = [x + y + I_1 + I_2; x + y + 0 + 0]$. Three choices were made for each task as indicated by the subscripts 1, 2 and 3. ± denotes a zero-mean (50/50) risk yielding $+a$ or $-a$, i.e. $[+a; -a]$. Note that whether choosing A or B comprises a choice consistent with risk apportionment differs across treatments.

Table XI: Lotteries Waiting Condition

	WGTG				WGTL				WLTG				WLTL			
Trait	x	y	I_1	I_2	x	y	I_1	I_2	x	y	I_1	I_2	x	y	I_1	I_1
RA − X_1	+€11	+20 min	+€6	+€12	+€11	+20 min	+€6	+€12	+€29	+20 min	-€6	-€12	+€29	+20 min	-€6	-€12
RA − X_2	+€14	+20 min	+€4	+€8	+€14	+20 min	+€4	+€8	+€26	+20 min	-€4	-€8	+€26	+20 min	-€4	-€8
RA − X_3	+€8	+20 min	+€8	+€16	+€8	+20 min	+€8	+€16	+€32	+20 min	-€8	-€16	+€32	+20 min	-€8	-€16
RA − Y_1	+€20	+35 min	-10 min	-20 min	+€20	+5 min	+10 min	+20 min	+€20	+35 min	-10 min	-20 min	+€20	+5 min	+10 min	+20 min
RA − Y_2	+€20	+32 min	-8 min	-16 min	+€20	+8 min	+8 min	+16 min	+€20	+32 min	-8 min	-16 min	+€20	+8 min	+8 min	+16 min
RA − Y_3	+€20	+29 min	-6 min	-12 min	+€20	+11 min	+6 min	+12 min	+€20	+29 min	-6 min	-12 min	+€20	+11 min	+6 min	+12 min
X − RA_1	+€17	+25 min	+€6	-10 min	+€17	+15 min	+€6	+10 min	+€23	+25 min	-€6	-10 min	+€23	+15 min	-€6	+10 min
X − RA_2	+€18	+24 min	+€4	-8 min	+€18	+16 min	+€4	+8 min	+€22	+24 min	-€4	-8 min	+€22	+16 min	-€4	+8 min
X − RA_3	+€16	+23 min	+€8	-6 min	+€16	+17 min	+€8	+6 min	+€24	+23 min	-€8	-6 min	+€24	+17 min	-€8	+6 min
PR − X_1	+€17	+20 min	+€6	±€8	+€17	+20 min	+€6	±€8	+€23	+20 min	-€6	±€8	+€23	+20 min	-€6	±€8
PR − X_2	+€18	+20 min	+€4	±€12	+€18	+20 min	+€4	±€12	+€22	+20 min	-€4	±€12	+€22	+20 min	-€4	±€12
PR − X_3	+€16	+20 min	+€8	±€10	+€16	+20 min	+€8	±€10	+€24	+20 min	-€8	±€10	+€24	+20 min	-€8	±€10
PR − Y_1	+€20	+25 min	-10 min	±8 min	+€20	+15 min	+10 min	±8 min	+€20	+25 min	-10 min	±8 min	+€20	+15 min	+10 min	±8 min
PR − Y_2	+€20	+24 min	-8 min	±6 min	+€20	+16 min	+8 min	±6 min	+€20	+24 min	-8 min	±6 min	+€20	+16 min	+8 min	±6 min
PR − Y_3	+€20	+23 min	-6 min	±10 min	+€20	+23 min	-6 min	±10 min	+€20	+23 min	-6 min	±10 min	+€20	+17 min	+6 min	±10 min
X − PR − X_1	+€17	+20 min	+€6	±8 min	+€17	+20 min	+€6	±8 min	+€23	+20 min	-€6	±8 min	+€23	+20 min	-€6	±8 min
X − PR − X_2	+€18	+20 min	+€4	±6 min	+€18	+20 min	+€4	±6 min	+€22	+20 min	-€4	±6 min	+€22	+20 min	-€4	±6 min
X − PR − X_3	+€16	+20 min	+€8	±10 min	+€16	+20 min	+€8	±10 min	+€24	+20 min	-€8	±10 min	+€24	+20 min	-€8	±10 min
X − PR − Y_1	+€20	+25 min	±€8	-10 min	+€20	+15 min	±€8	+10 min	+€20	+25 min	±€8	-10 min	+€20	+15 min	±€8	+10 min
X − PR − Y_2	+€20	+24 min	±€12	-8 min	+€20	+16 min	±€12	+8 min	+€20	+24 min	±€12	-8 min	+€20	+16 min	±€12	+8 min
X − PR − Y_3	+€20	+23 min	±€10	-6 min	+€20	+17 min	±€10	+6 min	+€20	+23 min	±€10	-6 min	+€20	+17 min	±€10	+6 min
TE − X_1	+€20	+20 min	±€8	±€8	+€20	+20 min	±€8	±€8	+€20	+20 min	±€8	±€8	+€20	+20 min	±€8	±€8
TE − X_2	+€20	+20 min	±€12	±€4	+€20	+20 min	±€12	±€4	+€20	+20 min	±€12	±€4	+€20	+20 min	±€12	±€4
TE − X_3	+€20	+20 min	±€10	±€6	+€20	+20 min	±€10	±€6	+€20	+20 min	±€10	±€6	+€20	+20 min	±€10	±€6
TE − Y_1	+€20	+20 min	±8 min	±8 min	+€20	+20 min	±8 min	±8 min	+€20	+20 min	±8 min	±8 min	+€20	+20 min	±8 min	±8 min
TE − Y_2	+€20	+20 min	±10 min	±10 min	+€20	+20 min	±10 min	±10 min	+€20	+20 min	±10 min	±10 min	+€20	+20 min	±10 min	±10 min
TE − Y_3	+€20	+20 min	±5 min	±5 min	+€20	+20 min	±5 min	±5 min	+€20	+20 min	±5 min	±5 min	+€20	+20 min	±5 min	±5 min
X − TE_1	+€20	+20 min	±€8	±8 min	+€20	+20 min	±€8	±8 min	+€20	+20 min	±€8	±8 min	+€20	+20 min	±€8	±8 min
X − TE_2	+€20	+20 min	±€12	±6 min	+€20	+20 min	±€12	±6 min	+€20	+20 min	±€12	±6 min	+€20	+20 min	±€12	±6 min
X − TE_3	+€20	+20 min	±€10	±10 min	+€20	+20 min	±€10	±10 min	+€20	+20 min	±€10	±10 min	+€20	+20 min	±€10	±10 min

Notes. This his table describes the parameters of the lotteries that were used in each of the treatments of the Waiting condition. RA (PR, TE) refers to risk aversion (prudence, temperance), attribute X is wealth, attribute Y is waiting time, and an "X" before the entry indicates a cross-trait. Respondents were asked to choose between the lottery $A = [x + y + I_1 + 0; x + y + I_2 + 0]$ and $B = [x + y + I_1 + I_2; x + y + 0 + 0]$. Three choices were made for each task as indicated by the subscripts 1, 2 and 3. $\pm$ denotes a zero-mean (50/50) risk yielding $+a$ or $-a$, i.e. $[+a; -a]$. Note that whether choosing A or B comprises a choice consistent with risk apportionment differs across treatments.

Table XII: Lotteries Social Condition

Trait	YGOG				YGOL				YLOG				YLOL			
	x	y	I_1	I_2	x	y	I_1	I_2	x	y	I_1	I_2	x	y	I_1	I_1
RA − X_1	+€9	+€14	+€4	+€6	+€9	+€14	+€4	+€6	+€19	+€14	-€4	-€6	+€19	++€14	-€4	-€6
RA − X_2	+€10	+€14	+€6	+€2	+€10	+€14	+€6	+€2	+€18	+€14	-€6	-€2	+€18	+€14	-€6	-€2
RA − X_3	+€9	+€14	+€2	+€8	+€9	+€14	+€2	+€8	+€19	+€14	-€2	-€8	+€19	+€14	-€2	-€8
RA − Y_1	+€14	+€9	+€4	+€6	+€14	+€19	-€4	-€6	+€14	+€9	+€4	+€6	+€14	+€19	-€4	-€6
RA − Y_2	+€14	+€10	+€6	+€2	+€14	+€18	-€6	-€2	+€14	+€10	+€6	+€2	+€14	+€18	-€6	-€2
RA − Y_3	+€14	+€9	+€2	+€8	+€14	+€19	-€2	-€8	+€14	+€9	+€2	+€8	+€14	+€19	-€2	-€8
X − RA_1	+€12	+€12	+€4	+€4	+€12	+€16	+€4	-€4	+€16	+€12	-€4	+€4	+€16	+€16	-€4	-€4
X − RA_2	+€11	+€11	+€6	+€6	+€11	+€17	+€6	-€6	+€17	+€11	-€6	+€6	+€17	+€17	-€6	-€6
X − RA_3	+€13	+€13	+€2	+€2	+€13	+€15	+€2	-€2	+€15	+€13	-€2	+€2	+€15	+€15	-€2	-€2
PR − X_1	+€12	+€14	+€4	±€5	+€12	+€14	+€4	±€5	+€16	+€14	-€4	±€5	+€16	+€14	-€4	±€5
PR − X_2	+€11	+€14	+€6	±€4	+€11	+€14	+€6	±€4	+€17	+€14	-€6	±€4	+€17	+€14	-€6	±€4
PR − X_3	+€13	+€14	+€2	±€7	+€13	+€14	+€2	±€7	+€15	+€14	-€2	±€7	+€15	+€14	-€2	±€7
PR − Y_1	+€14	+€12	+€4	±€5	+€14	+€16	-€4	±€5	+€14	+€12	+€4	±€5	+€14	+€16	-€4	±€5
PR − Y_2	+€14	+€11	+€6	±€4	+€14	+€17	-€6	±€4	+€14	+€11	+€6	±€4	+€14	+€17	-€6	±€4
PR − Y_3	+€14	+€13	+€2	±€7	+€14	+€15	-€2	±€7	+€14	+€13	+€2	±€7	+€14	+€15	-€2	±€7
X − PR − X_1	+€12	+€14	+€4	±€5	+€12	+€14	+€4	±€5	+€16	+€14	-€4	±€5	+€16	+€14	-€4	±€5
X − PR − X_2	+€11	+€14	+€6	±€4	+€11	+€14	+€6	±€4	+€17	+€14	-€6	±€4	+€17	+€14	-€6	±€4
X − PR − X_3	+€13	+€14	+€2	±€7	+€13	+€14	+€2	±€7	+€15	+€14	-€2	±€7	+€15	+€14	-€2	±€7
X − PR − Y_1	+€14	+€12	±€5	+€4	+€14	+€16	±€5	-€4	+€14	+€12	±€5	+€4	+€14	+€16	±€5	-€4
X − PR − Y_2	+€14	+€11	±€4	+€6	+€14	+€17	±€4	-€6	+€14	+€11	±€4	+€6	+€14	+€17	±€4	-€6
X − PR − Y_3	+€14	+€13	±€7	+€2	+€14	+€15	±€7	-€2	+€14	+€13	±€7	+€2	+€14	+€15	±€7	-€2
TE − X_1	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5
TE − X_2	+€14	+€14	±€4	±€6	+€14	+€14	±€4	±€6	+€14	+€14	±€4	±€6	+€14	+€14	±€4	±€6
TE − X_3	+€14	+€14	±€7	±€3	+€14	+€14	±€7	±€3	+€14	+€14	±€7	±€3	+€14	+€14	±€7	±€3
TE − Y_1	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5
TE − Y_2	+€14	+€14	±€4	±€6	+€14	+€14	±€4	±€6	+€14	+€14	±€4	±€6	+€14	+€14	±€4	±€6
TE − Y_3	+€14	+€14	±€7	±€3	+€14	+€14	±€7	±€3	+€14	+€14	±€7	±€3	+€14	+€14	±€7	±€3
X − TE_1	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5	+€14	+€14	±€5	±€5
X − TE_2	+€14	+€14	±€4	±€4	+€14	+€14	±€4	±€4	+€14	+€14	±€4	±€4	+€14	+€14	±€4	±€4
X − TE_3	+€14	+€14	±€7	±€7	+€14	+€14	±€7	±€7	+€14	+€14	±€7	±€7	+€14	+€14	±€7	±€7

Notes. This table describes the parameters of the lotteries that were used in each of the treatments of the Social condition. RA (PR, TE) refers to risk aversion (prudence, temperance), attribute X is own wealth, attribute Y is wealth of other, and an "X" before the entry indicates a cross-trait. Respondents were asked to choose between the lottery $A = [x+y+I_1+0; x+y+I_2+0]$ and $B = [x+y+I_1+I_2; x+y+0+0]$. Three choices were made for each task as indicated by the subscripts 1, 2 and 3. $\pm$ denotes a zero-mean (50/50) risk yielding $+a$ or $-a$, i.e. $[+a; -a]$. Note that whether choosing A or B comprises a choice consistent with risk apportionment differs across treatments.