Choices, Frames & Personal Values – Griffiths, Thomas & Dyer

Draft

1. Introduction

People are rarely completely rational in their decision-making. Even when they endeavour to be so, uncertainties arising from complex interactions of environmental variables often contribute to suboptimal outcomes. Individuals make intuitive choices influenced by frames of reference and irrational assessments of value based on perceptions of risk (Kahneman & Tversky, 1984). Both are likely to be influenced by expertise (e.g., Burke & Miller, 1999; Salas, et al. 2009), experience (Juliusson, Karlsson, & Gärling, 2005), and cognitive biases (Stanovich & West, 2008), which, in turn, are subject to genetic factors, including those relating to personality (e.g., Haselton et al, 2015; Paunonen, 2003). Risk-Sensitivity Theory (RST; Caraco et al., 1980) predicts that decision makers shift from risk-aversion to risk-preference as need dictates, where need describes the disparity between an individual's present state and desired (or goal) state (Ermer et al., 2008; Stephens, 1981).

An individual's needs are reflected in unconscious and conscious assessments of what is valuable or important to them according to their personal values (Schwartz, 1992). Personal values are abstract beliefs that serve as trans-situational motivational goals that, when activated, elicit emotional responses that guide decision-making (e.g., Arciniega, et al., 2019; Bardi & Schwartz, 2003). As such, it is apparent personal values serve as a form of psychological currency in which the relative benefits of disparate concepts may be evaluated and compared on a like for like basis (Brosch & Sander, 2013): translating environmental inputs into emotional outputs recognised as feelings that influence choice. This suggests they are components of system 1 (Stanovich & West, 2000) thinking, based on intuition and instinct, as well as being heritable (Twito & Knafo-Noam, 2020) components of personality (Griffiths et al, in press; Parks-Leduc et al, 2015).

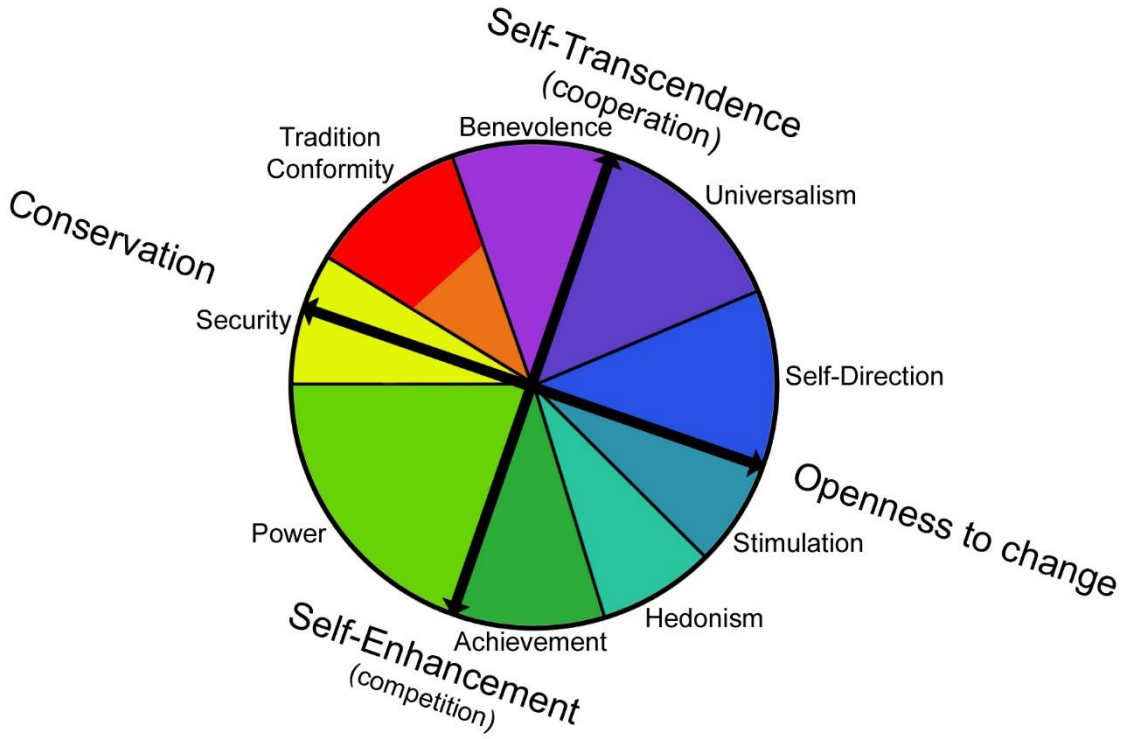


Fig. 1 The Schwartz (1992) Values Circle

Schwartz (1992) describes a systemic motivational construct comprising ten values that serve as guiding principles for life, orientated around two orthogonal axes: conservation to openness to change, and self-enhancement to self-transcendence, as shown in fig. 1. Values adjacent to each other tend to serve similar needs and promote similar behaviors, whereas those opposite tend to correlate negatively, both in the behaviors they promote and how they are prioritized by individuals. For example, in a study exploring the role of values in decisions to buy fair-trade goods, Doran (2009) found that the importance individuals placed on universalism alone accounted for 20% of purchase variation. The neighbouring value of self-direction also correlated positively, while the opposing values of conformity, security, power, achievement, and hedonism all correlated negatively.

Given the inextricable relationship between values and affect (Schwartz, 1992), and Zajonc's (1980) consideration that all perceptions are subject to affect, values seem likely to exert an influence on all decision-making via the affect heuristic (Slovic, et al., 2007). If emotions are evolved responses that

encourage behavior likely to increase an organism's chances of survival and reproduction (e.g., Rolls, 2014), in line with Brosch and Sander's (2014) interpretation of Rolls' (2014) theoretical account of the role of emotions in decision-making, values likely play a naturally selected role in assessing the reward and punishment potential of environmental inputs. Given that values are known to be environmentally adaptive (e.g., Daniel et al., 2013), and intuitive thinking is subject to both genetic and experiential influences (e.g., Epstein, 2010), it may be that the influence of values on individual decision-making is similarly multi-layered.

Cognitive-experiential self-theory (CEST) (Epstein, 2003) describes a system of personality with an 'experiential' adaptive unconscious component comparable to the intuitive component of dual-system thinking (Sloman, 1996). In CEST the heuristics associated with experiential thinking are mediated by affect and viewed as components of adaptive processes linked to survival and reproductive needs humans share with other animals; suggesting they evolved prior to distinctively human intelligence and system 2 (Stanovich & West, 2000) rational thinking.

In exploring a means to unify theoretical perspectives on decision-making under risk, such as 'rule of thumb' heuristics, the greater weighting of potential losses relative to gains in Prospect Theory (Kahneman & Tversky, 1979), and the needs-sensitive foraging preferences described by RST (Caraco, et al., 1980), Mishra (2014) considers need and motivation to be means by which to extend RST from its animal behavioral roots to humans. In RST decision-making is geared toward satisficing (Simon, 1956), i.e., settling on solutions that are good enough rather than optimal. This is informed by fitness-related survival and reproductive costs and returns associated with actions in stochastic environments.

1.1 An Evolutionary Perspective in Personal Values

XXXXXX, et al. (2021) offer a radical theoretical evolutionary perspective on the origins of human values and their role in decision-making. This considers them in terms of universal schema arising from fundamental physical motivations present in all evolutionary systems. In organisms, these

express themselves as need. It proposes that motivational factors equivalent to all ten values may be inferred as operating in the universal system, and these are internalised by local systems incrementally as they: gain stability, become complex adaptive systems (CAS), and, in the case of humanity, evolve to replicate all ten in sympathy with Deutsch's (2011, p.59) conceit of humans as 'universal constructors' – "factories for transforming anything into anything that the laws of nature allow". The internalisation of this system of equivalents in Schwartz's (1992) system of personal values resonates with Simon's (1995, p.26) description of how CAS may evolve to become "sets of boxes nesting within sets of boxes", and Gell-Mann's (1994) description of CAS replicating schema present in the greater systems of which they are part.

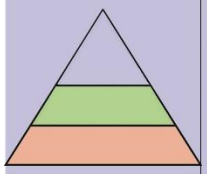
Firstly, uniform local systems such as atoms emerge and persist in states of energetic equilibrium: so internalising equivalents of benevolence (localised conservation of energy being equivalent to Schwartz's (1992) references to in-group cooperation), tradition and conformity (consistency through time and space), and security (regulated behavior with reference to boundaries). Secondly, organisms emerge, internalising equivalents to power (influence and control over external resources for competitive gain, e.g., metabolism, foraging, predation, immune responses, etc.) and achievement (success in relation to recognized benchmarks, e.g., natural and sexual selection) that actively promote competition. Thirdly, abilities to instigate change in ways that mimic the chaotic interactions responsible for: environmental variation, the emergence of new systems, genetic mutation, and evolution, are internalised for increasingly targeted, local system specific benefits, giving rise to equivalents of hedonism and stimulation. Examples of such exploratory mechanisms include that by which cellular cytoskeletons are formed when randomly directed filaments sent out from nuclei form satisfactory connections with cell membranes (Kirschner & Mitchison, 1986), and the playfulness and adventurousness of intelligent organisms such as apes (Pellegrini, et al., 2007) and octopi (Zylinski, 2015). Finally, in humanity, the values of self-direction (independent thought and action), universalism (understanding nature), and a form of non-localised benevolence that extends beyond close genetic relatedness or symbiosis, are internalized. Universal equivalents to

these values are inferred in entropy in the direction of time's arrow, all the information in the universe, and conservation of energy respectively.

Considered in this light, the Schwartz (1992) system of values represents four stages of broad ancestral strategic development. The conservative values promote stability, continuity, order, and resistance to potentially disruptive forces. The self-enhancing/competitive values facilitate change, insofar as they promote demonstrably successful/fitness-enhancing novel behaviors. The openness to change/progressive values promote risk-taking in what is effectively 'research and development', that becomes increasingly targeted: from hedonism (having fun), through stimulation (seeking novelty and adventure) to self-direction (targeted curiosity, independent thought and action). Finally, the self-transcending values work with self-direction to accelerate universal understanding, creativity, and innovation through cooperation (sharing endeavour and information).

Consistent with the systemic nature of personal values, they and the behaviors they promote are bound to evolve with respect to each other, other systems with which they interact, and the greater systems of which they are part. Individuals most motivated by self-direction and the self-transcending values may be responsible for innovations (such as the Internet) that, over time, become progressively attractive to those motivated most by values lower in the hierarchy: firstly, to those seeking fun and novelty (openness values); then, those seeking a competitive advantage (self-enhancing values); and finally, when innovations become fully established and broadly accepted, those seeking order and stability (conservation values). However, the reverse is also possible: that those most resistant to change eschew cultural, scientific, and technological progress, and seek to restore a previous orderly state, e.g., the Amish and Islamic State.

The progressive evolutionary structure described above resonates with Maslow's (1943) hierarchy of needs. As shown in fig.2, comparison between the values Maslow (1987) associated with each level of his hierarchy and those of the Schwartz (1992) system shows a broad sequential alignment.

Maslow Need Type	Maslow Values/Qualities	Schwartz Values
Self-Actualization *(B-Values)* 	Wholeness	inner harmony, unity with nature (**universalism**)
	Perfection (balance and harmony)	.. ..
	Completion	.. .. , wisdom, world at peace (**universalism**)
	Justice	social justice, equality (**universalism**)
	Simplicity	honesty (**benevolence**)
	Liveliness (spontaneity)	exciting life (**stimulation**)
	Beauty	world of beauty (**universalism**)
	Goodness (benevolence)	helpful, forgiving, honest, loyal, etc. (**benevolence**)
	Uniqueness (individuality)	independence, setting own goals (**self-direction**)
	Playfulness	creativity, freedom (**self-direction**)
		enjoying life (**hedonism**)
	Truth (reality)	honesty (benevolence) wisdom (**universalism**)
	Autonomy	independence, setting own goals (**self-direction**)
	Meaningfulness	meaning in life (**benevolence**)
	Close Friendships	true friendship (**benevolence**)
	Curiosity & Knowledge	curiosity (**self-direction**), wisdom (**universalism**)
Esteem *(D-Values)*	Self-Respect	self-respect (**achievement**)
	Competence	capable (**achievement**)
	Reputation and Appreciation & Recognition	preserving public image (**power**), social recognition (**power** and **achievement**)
	Status and Dominance	social power (**power**)
	Achievement	**achievement**
	Mastery	success, capable (**achievement**)
Love & Belonging *(D-Values)*	Friendship	reciprocation of favours (**security**), true friendship (**benevolence**)
	Belonging	associated with **benevolence, tradition, conformity & security**
Safety *(D-Values)*	Safety	healthy, clean (**security**)
	Law & Order	honouring parents & elders (**conformity**), social order (**security**)
	Security	family security, national security (**security**)

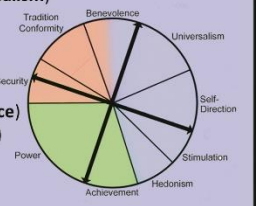


Fig. 2. Comparison of Maslow's (1987) hierarchy of needs and Schwartz's (1992) values

If Maslow's 'safety' and 'love and belonging' needs are considered as one, their associated values correspond with Schwartz's conservation values and some benevolence values. In placing conservative safety needs below (i.e., to consider them more fundamental than) cooperative love and belonging needs Maslow appears to have failed to recognise the latter as preconditions for safe physiological existence: cooperation between gametes being fundamental to the existence of every human life, and cooperation between family and tribe members being fundamentally important to humanity (Boyd & Richerson, 2009). Maslow's (1987) esteem needs correspond with the values of power and achievement, and his self-actualization needs principally to self-direction, universalism, and the remaining benevolence values. One can also link the hedonism value of 'enjoying life' and the stimulation value of 'exciting life' with Maslow's self-actualizing values of playfulness and liveliness.

The discovery that Maslow's 'higher' needs appear to operate independently of 'lower' needs (e.g., Wahba & Bridwell, 1976), and so their activation is not dependent on the satisfaction of lower needs, is consistent with what might be expected given the heritability of values (Twito & Knafo-Noam, 2020) and the shuffling of genes that takes place in meiosis. So, while one can infer a rational,

developmental progression from the effective strategies one might associate with the lowest values (tradition and conformity – 'follow others') to those associated with the highest (self-direction, universalism, and benevolence – 'think and act independently, develop a deep and wide understanding, and share openly and honestly'), individuals may be subject to genetic predispositions for pursuing mixed, potentially inconsistent strategies.

Maslow's belief in the superior decision-making potential of self-actualizing individuals found expression in his concept of eupsychian management: a utopian organizational principle based on self-actualizing values. Through the work of Downton (1973) and Burns (1978), this evolved into Transformational Leadership Theory (Bass, 1985), in which transformational leaders seek to raise up their followers' needs in relation to Maslow's (1943) hierarchy, while transactional leaders seek to motivate followers by means of short-term, financial or status related rewards and punishments. Transformational leadership has been shown to be widely advantageous (e.g., Chang, 2016; Lehmann-Willenbrock, et al. Meinecke, Rowold & Kauffeld, 2015), particularly in challenging environments in which there is continuous change (Fuller et al., Patterson, Hester, & Stringer, 1996; Lowe, et al. Kroeck, & Sivasubramaniam, 1996). It has been positively associated with improved performance (Wang & Howell, 2010), colleague approval (Johnson, et al. Venus, Lanaj, Mao & Chang, 2012), positive affect among colleagues (Lanaj, et al.; Johnson, & Lee, 2016), and in addressing issues related to gender equality and employee empowerment (Tuuk, 2012). Unsurprisingly, links between leaders' styles and their personal values - between transformational leadership and self-actualizing/self-transcending (or stakeholder) values, and between transactional leadership and self-enhancing (or economic) values - have been found in many studies (e.g., Castillo, et al, 2018; Groves & LaRocca (2011); Jamal (2014).

It is common for research concerning the influence of values on decision-making and behavior to be based on correlations between the mean cross-sample importance of values and particular decisions or behaviors (e.g., Bardi & Schwartz, 2003; Doran, 2009). While such correlations may identify broad influences, it is rather the structure of individual motivational systems – i.e., the relative importance

individuals attach to their values - that characterises them and guides their judgement and behavior (Schwartz, 1992). Therefore, the nature of these systems would seem to offer a more promising line of inquiry when investigating values-related decision-making biases.

By way of a geographical illustration of why this should be, such topological features as hilltops and valley floors are purely a function of localised differences in the height of land above sea level. Hilltops, by definition, are always immediately surrounded by lower land, and valley floors by higher land on two sides. This tends to give rise to non-localised correlations between high land and hilltops, and between low land and valley floors. However, valley floors are abundant in mountainous areas, as are hilltops in lowland areas. Accordingly, generalised correlations between spot heights and topological features will tend to underestimate the relationship between them.

The influence of any one value cannot be fully revealed in the score generated by responses to a questionnaire such as the Schwartz, et al., (2001) PVQ-40. For example, self-direction's relationships with independent thought and action are likely mediated by the breadth and depth of knowledge facilitated by universalism and benevolence, and subject to the influence of the opposing values of tradition to achievement. Logically, an individual bound by religious beliefs and customs (tradition), or inclined to copy others (conformity), or attach great importance to the perceived safety of regulation and boundaries (security), or to maintain the good opinion of, or gain influence over, others (power), or a desire to earn the approval and respect of others (achievement) will be restricted in their capacities for independent thought and action relative to others for whom these values are relatively less important. Accordingly, to better understand the relationship between values and decision-making biases, we set out to account for differences in individual motivational systems: distinguishing between those motivated most by values attributable to different levels of an evolutionary interpretation of Maslow's hierarchy. We chose to this by presenting a large number of individuals a selection of a simple quandaries adapted from Kahneman and Tversky (Kahneman, 2011) and others.

1.4` Theoretical Expectations

If XXXXX, et al's (2021) hierarchical, evolutionary interpretation of Schwartz's (1992) values is more than plausible speculation, evidence should be available to demonstrate hierarchical influences on decision-making in addition to those associated with the circle. If the equivalents of conservative values were governing all stable systems before life evolved and continued to dominate the motivation of organisms when self-enhancing competitive motives related to survival and reproduction were internalised, it seems likely that they were responsible for laying the deepest foundations of our intuitive/system 1/experiential thinking (e.g., Sloman, 1996): those that pre-dated the evolution of intelligence. If equivalents of these values dominate the motivational systems of most animals, it seems likely the conservative and self-enhancing values are most likely to promote behavior and decision-making biases associated with RST: i.e., an aversion to risk that diminishes only when the returns available from safe investments are inadequate to satisfy basic needs. If the self-enhancing values later became differentiated from the conservative values to facilitate fitness-enhancing change, they would seem likely to promote a greater preparedness to take risks when the balance between personal costs and benefits is favourable. The openness to change values of hedonism and stimulation seem likely to encourage the greatest preparedness for risk-taking.

The decision-making biases so far described could just as well be attributed to the circular arrangement of the values as to a hierarchical one. It is the roles played by self-direction's independent thought and action, universalism's wisdom, and a rational, universalist approach to benevolence, that potentiate the possibility of discovering a hierarchical influence. These values would appear to be uniquely associated with the type of intelligence associated with rational/system 2 thinking (Stanovich & West, 2000) and creative thinking. Because patterns of effortful thought may, through repetition, be delegated to intuitive thinking in line with the brain's drive toward greater efficiency (e.g., Clegg et al., 1998), their influence may have observable effects on heuristics. In line with Maslow's (1943) belief that self-actualizing individuals are more at ease - not having to

devote so much of their energies to satisfying their more basic needs - it is possible they will be among the least risk-averse. But also, if their motivation for gain is less, this may make them less interested in risk-taking. Unlike the more generalised motivation for experimentation and risk-taking associated with hedonism and stimulation, self-actualizing individuals seem more likely to adopt investment strategies that promote risk-taking only in pursuit of certain innovative or self-transcending goals.

If values are inextricably linked to affect (Schwartz, 1992) and influence most decision-making through the affect heuristic (Slovic, et al., 2007; see also Zajonc, 1980), and differences in the relative importance individuals attach to values correspond to different intuitive judgements, such as the discount function (see Frederick, et al., 2002) applied to future gains, one is invited to consider what happens when no one set of values is more important than any other. People subject to values conflicts, whose most important values oppose and counteract each other, seem likely to be prone to mixed feelings that cannot easily be resolved in an intuitively satisfactory decision. As such, they seem less likely to exhibit consistent intuitive decision-making biases and may be more likely to resolve intuitive dilemmas through rational analysis. Deciding whether to defer gratification has been associated with increased neural activity in the pre-frontal cortex, which is itself associated with rational thought (Casey, et al., 2011; McClure et al., 2004). Accordingly, if a deferred gratification proposition were to elicit values-driven, intuitive, and irrational responses, it may be individuals subject to values conflicts may respond differently to and more rationally than others.

Many factors, such as status (Samuelson & Allison, 1994) and age (Besedes, et al., 2012), have the potential to play moderating roles that may obscure the influence of values. Also, for some propositions, for example, when the disparity between the effective values of a binary proposition exceeds a certain threshold, the riskiness of one option would be so great as to be rejected by all individuals regardless of their personal values: who would choose the certainty of receiving one cent in preference to a fair coin tossed opportunity to win $100,000 on heads or lose one cent on tails?

However, beneath this threshold, and regardless of moderating factors, it seems likely that values do have a discernible influence.

1.5 This research

The present study aimed to explore values-related biases in decision-making, particularly those sympathetic to the aforementioned theoretical expectations, i.e.:

1) Those individuals for whom the conservative values are the most important will be the most risk-averse and the least intelligent and creative;
2) Those for whom the self-enhancing values are the most important will be the next most risk-averse and creative, but being the most motivated by personal gain, will be the most likely to pursue gains when potential losses, relative to potential gains, are relatively small, or when losses are disproportionately shared by others;
3) Those for whom the progressive values of hedonism and stimulation are the most important will be the least risk averse;
4) Those for whom the self-actualizing and -transcending values are the most important, will be the least sensitive to potential losses, the most likely to prioritise the interests of others, the most intelligent, the most likely to give 'improved', rationally supportable intuitive responses, and be the most creative problem solvers;
5) Those most likely to be subject to values-conflicts – i.e., those without a dominant value or suite of sympathetic values – will be the most likely to respond rationally when propositions appear to elicit irrational values-driven responses.

We tested a large group of individuals with questions adapted from Kahneman (2011), a Bayesian inference challenge, and fluid intelligence and creativity tests. While no detailed hypotheses were pre-registered, these may be inferred in the evolutionary theory of XXXX, et al (2021), which itself was based on XXXXX (2013).

2. Method

2.1 Procedure

Approval was granted by the ethical committees of XXXX University (Phases 1 & 2) and XXXX University (Phase 3). Through a combination of personal invitations sent to organizations and advertisements placed on psychological research platforms (Psychological Research on the Net and Social Psychology Network) and at XXXX University psychology department, participants were recruited to complete online questionnaires in which they were presented with a values-related questionnaire followed by a series of decision-making challenges. No financial inducements were involved. Some participating students received psychology course credits and all participants were offered a free personal values profile based on their responses accompanied by interpretative guidance notes.

Data was collected in three phases from 2014 to 2021. The same values questions were presented in all cases, but the decision-making challenges were modified between phases. From 1405 responses, after the pre-planned removal of data from: (1) 94 individuals declaring that English was neither their first language nor a language in which they had acquired naturalized proficiency, (2) duplicate entries from the same participants, and (3) 10 individuals who responded by sequentially repeating the same answer to most of the value questions, a total of 1325 individual responses remained. While all these were analysed (see supplementary materials, fig. SM1), the results presented here are based on data from 1257 participants, after a further 68 were removed having repeated the same answer to a previous values question for a total of 12 times or more, including a sequential run of 5 or more.[1]

2.2 Participants

[1] While it is not possible to determine whether responses reflect individuals' values, given these questions are not presented in groups relating to sympathetic values, frequent repetition of responses suggests an individual's true value priorities are not being represented. The 68 deletions appeared to reduce statistical noise and increase value-decision correlations. While other suspicious repetitive patterns were investigated, it was not possible to determine whether these arose from spurious entries.

Phase 1 involved 189 professional employees of commercial and not for profit organizations with an age range from 22 to 67[2] (*M* = 44.6, *SD* = 10.4). Phase 2 involved 183 professionals from commercial organizations, all but 17 being from a large engineering organization. Of those six whose ages were recorded the age range was 24 to 58 years (*M* = 35.2, *SD* = 12.0), the remainder were mainly drawn from a group of 'high achievement potential' employees whose individual ages were not recorded but were aged between 25 and 40. In phases 1 and 2, 316 participants were recorded as British, 33 as North Americans, 25 as North Europeans, 9 as South-East Asians and the remainder were unrecorded. Phase 3 involved 885 respondents aged between 14 and 72 years (*M* = 25.2, *SD* = 10.5). Of these 499 were North American, 167 were British, 50 were Asian, and the remainder were Other European, Australasian, African, and Other. The educational levels of participants were not recorded but professional participants were mostly educated to degree level and most of those responding to the advertisements of psychological research platforms gave email addresses that suggested they were involved in higher education.

2.3 Materials

Values data was collected with a 40-item, gender neutral, multiple-choice Schwartz Portrait Values Inventory questionnaire (PVQ-40; Schwartz et al., 2001) in which participants were asked to state the degree to which they associated themselves with the types of people being described (e.g., "They like surprises. It is important to them to have an exciting life") on a Likert scale (1 = not at all like me; 6 = very much like me).

The decision-making challenges presented in the various phases were as follows[3]:

1. Deferred gratification – two versions
    i. What would you prefer, £5,200 today or £5,600 next week? – Phase 1
    ii. What would you prefer, £5,200 today or £5,500 in a month from today? – Phase 3

[2] Across the whole sample 229 individuals provided either no or a false birth date. Age-related statistics were calculated after removing all voids and ages below 14 years and above 98 years.
[3] Questions 1-5 were adapted from Kahneman (2011). Question 6 was adapted from Paulos (1988).

2. Assuming you trust the other party to pay up if you won, would you take this bet: toss a coin - heads you lose £100 and tails you win £200? Yes or No (all phases)
3. You are responsible for spending a limited healthcare budget on one of two new medicines available to combat a life-threatening epidemic that could affect 1 million people and have to make an immediate decision on which one to use. They have the following curative properties: Medicine A will cure 30% of those infected; Medicine B has a 45% likelihood of curing all those infected and a 55% likelihood of curing none of those infected. Assuming these percentages are accurate, which do you choose? (all phases)
4. You are faced with making the following choices together.
    a. Firstly, choose between being given: £240 for certain, or a 25% chance to gain £1,000 and a 75% chance of gaining nothing?
    b. and then, taking a £750 loss for certain, or a £25% chance to lose nothing and a 75% of losing £1,000? (all phases)
5. If it takes 10 combine harvesters 10 minutes to harvest 10 hectares of wheat, how long would it take 20 combine harvesters to harvest 20 hectares? Options: 5, 10, 15 or 20 minutes. (Phases 1 & 3)
6. Bayesian inference challenge – two versions
    i. There is a potentially fatal bacterial infection known to be affecting 1% of the population. You are asked to attend a local clinic to be tested for infection as part of a national screening process. The test is 99% accurate. After testing you receive a letter from the clinic saying you have tested positively for infection and asking you to come back for further examination. What is the likelihood you have this bacterial infection? Open numerical answer: 0 – 100% (Phases 1 & 2)
    ii. 90% of the people in a remote mountain village are ‘Blutos’ and 10% are ‘Rimini’. A witness to a night crime in the village reports that the perpetrator was a Rimini. It is known that people such as this witness can distinguish between Blutos and Rimini

with 90% accuracy in similar conditions. What is the likelihood the witness got it right, and the criminal is a Rimini? Options: 10%, 50% or 90%. (Phase 3)

7. Fluid intelligence. Participants were sequentially presented with a maximum of ten puzzles (see Figure SM1- including eight Raven's Progression Matrices (RPM)(Raven, et al., 1998)) to be completed within a timer-controlled ten-minute window. (Phase 1)
8. Guilford's (1967) Alternative Uses Test - "How many uses can you think of for an empty plastic lemonade bottle?" To be completed in a timer-controlled in two-minute window. (Phase 1)

Except for Q6(i) and Q8, participants had to make choice between the available two to six options in respect of each question. Q7 was intended to investigate values-related biases in fluid intelligence and the influence of intelligence on answering the other decision-making challenges. Q7 was removed after Phase 1 to reduce the time demands on potential participants and thereby encourage greater participation, as were Q1, Q5 and Q8. Q1 and Q5 were reintroduced in Phase 3: Q1 in an amended form intended to elicit a greater variance in responses. In Phase 3, a different Bayesian inference challenge replaced the previous version - the aim being to improve the number of correct answers.

2.4 Analysis

In each of the phases the average score for each respondent's answers to the values-related questions was taken in respect of each of the ten values to enable the calculation of Pearson's correlations with: the binary options available for Q1, Q2, Q3 and Q4; the correct answers for Q5, Q6 (where appropriate) and Q7, and the number of suggestions for Q8. This enabled us to investigate potential linkage between individual values and decision-making biases.

Given that an individual's decision-making is subject to the influence of systematic relationships between their values, we also wanted to compare the decision-making of differently motivated individuals. To generate personal values profiles amenable to such analysis and cross referencing,

standard scores were calculated for each value in accordance with instructions from Schwartz (2004), with reference to centred value scores and standard deviations calculated from a norm group of 11,967 west Europeans from 12 western European nations, taken from the 2014 European Social Survey with an age range of 14 to 99 (*M*=43.1, *SD*=17.5). Standard scores were converted so that the lowest and highest could be represented within a 0-100% scale.

Given that values adjacent to each other in the Schwartz (1992) system tend to support similar needs and promote similar behaviors (e.g., Bardi & Schwartz, 2003), the average standard scores for ten sets of three neighbouring values centered on each value were calculated for each participant. This enabled each dominant suite of three values to be placed in one of ten groups: 1 - centered on tradition (including benevolence and conformity); 2 - centred on conformity (including tradition and security); and so forth … to 9 - centered on universalism (including self-direction and benevolence), and a tenth group, labelled 0, centered on benevolence (including universalism and tradition).

To aid the identification of biases sympathetic to the proposed hierarchical evolutionary structure, participants were further allocated to one of five motivational types: four hierarchical and one to represent those individuals most likely to be subject to motivational conflicts that might otherwise render them atypical. To facilitate this, participants in group 0 were further divided according to whether conformity or self-direction was more important to them. The former remained in group 0 while the latter were placed in a new group 10. Those in groups 0, 1, 2 and 3 were allocated to a type labelled Shepherds (for whom the conservative values were most important); those in groups 4 and 5 were allocated to a type labelled Hunters (driven most by self-enhancing values); those in groups 6 and 7 were allocated to a type labelled Explorers (driven most by hedonism and stimulation); and those in groups 8, 9 and 10 were allocated to a type labelled Philosophers (driven most by self-actualizing and self-transcending values).

A fifth motivational type labelled Moderators was used to describe those most likely to be subject to motivational conflicts. This comprised all those whose dominant group of three neighbouring values

failed to outscore the next highest scoring and potentially conflicting group by more than 6%. Potentially conflicting groups of values were taken to be those more than two away from each other when arranged around the circle (so sharing none of the same values), with groups 0 and 10 being considered separately (i.e., treating benevolence as if it comprised two values: one more associated with tradition, the other with universalism). For example, for an individual whose dominant values were in group 6, potentially conflicting values groups would be those from 0 to 3 and 9 and 10. The rationale being that, in a harmonious motivational system, the relative importance attached to neighbouring values is likely to be similar, and because they serve similar needs this is unlikely to give rise to motivational conflicts. The choice of the 6% threshold was arbitrary but informed by a desire to set it high enough to include a similar number of individuals to the other four types, but low enough to exclude individuals unlikely to experience conflicts between dominant suites of values. The composition of the analysed sample in terms of motivational types was as follows: Shepherds: *n* = 178, Hunters: *n* = 207, Explorers: *n* = 393, Philosophers: *n* = 210, Moderators: *n* = 269.[4] Average value profiles of each type are shown in the supplementary materials (Figure SM2).

Point biserial (Pearson) correlations between responses and each of the ten values were calculated for each of the decision-making challenges. The performance of participants in each motivational type was also analysed to provide Chi-Squared and percentage totals for each question. To explore whether differences in the performance of the four hierarchical motivational types would be exaggerated in individuals with larger differences between their dominant and subdominant suites of values, we also compared results when the threshold for allocating individuals to the Moderator type was set to 12% and 20% (see Figs. SM3 & SM4).

3. Results

[4] The type nomenclature and method of analysis described here belongs to XXXX XXXX XXXX. In line with the rationale explained here, this follows Maslow (1987) in allocating self-direction to a self-actualizing type with universalism and benevolence, rather than Schwartz (1992) in placing it with hedonism and stimulation in the higher order 'openness to change' value.

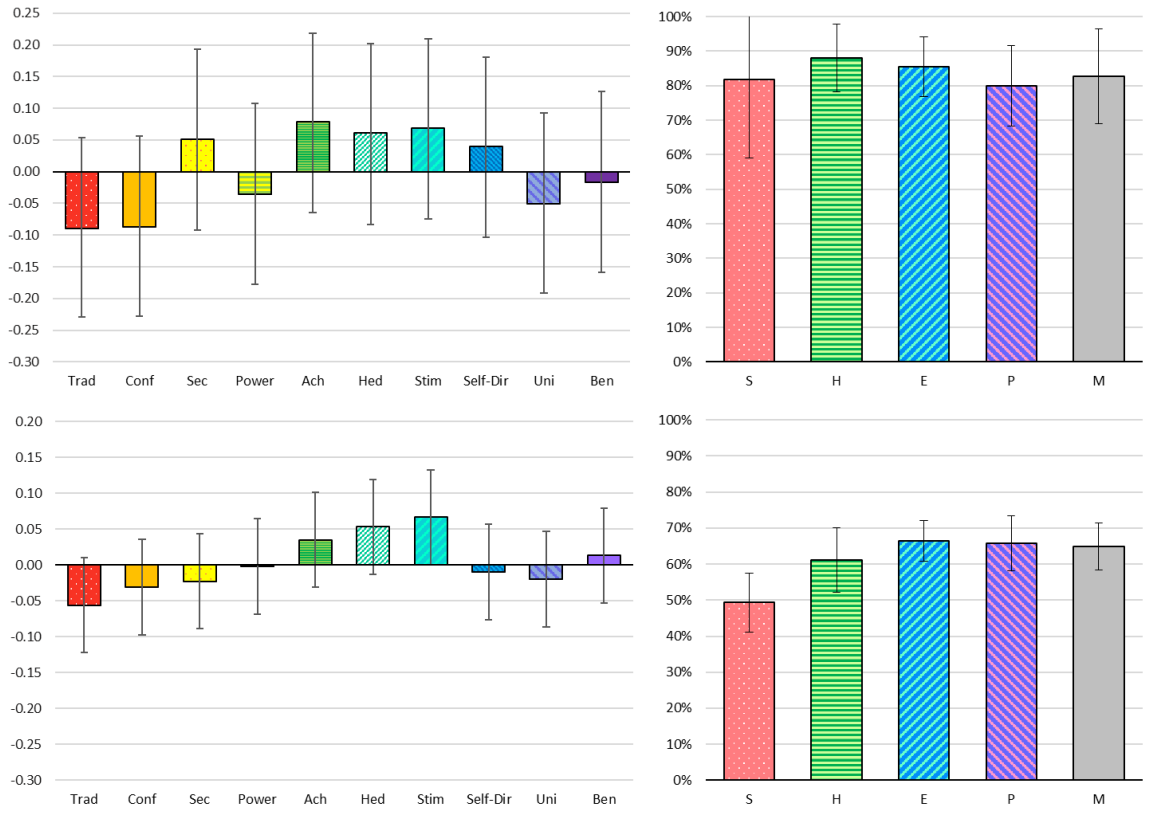


Fig. 4. Q1: Delayed Gratification – Values correlations (left) and motivational type preferences (right) for (i) £5,600 next week, *N*=189 (above) and (ii) £5,500 in a month's time, *N*=871 (below) to £5,200 today – in all figures: S = Shepherds, H = Hunters, E = Explorers, P = Philosophers, and M = Moderators. 95% Confidence intervals shown.

There were no significant correlations between any single value and responses to either version of Q1. However, as shown in fig. 4, similar systematic sinusoidal patterns of value-response correlations were evident in respect of both offers. In respect of Q1(i), 80-89% of all participants preferred to wait a week for £5,600, rather than take £5,200 today (i.e., applied a discount rate of less than 371% pa), with no significant difference between the motivational types. All types were less willing to wait a month for the smaller reward of £5,500. Relative enthusiasm to wait (and apply a discount rate of less than 65% pa) decreased in a hierarchal order from Philosophers, through Explorers and Hunters, to Shepherds: dropping from Q1(i) by 18%, 22%, 31% and 40% respectively. Only 49% of *N*=142 conservative Shepherds now preferred to wait, compared to 66% of *N*=268 Explorers: χ^2=11.38, 95% CI=0.27-0.07, p< .001.

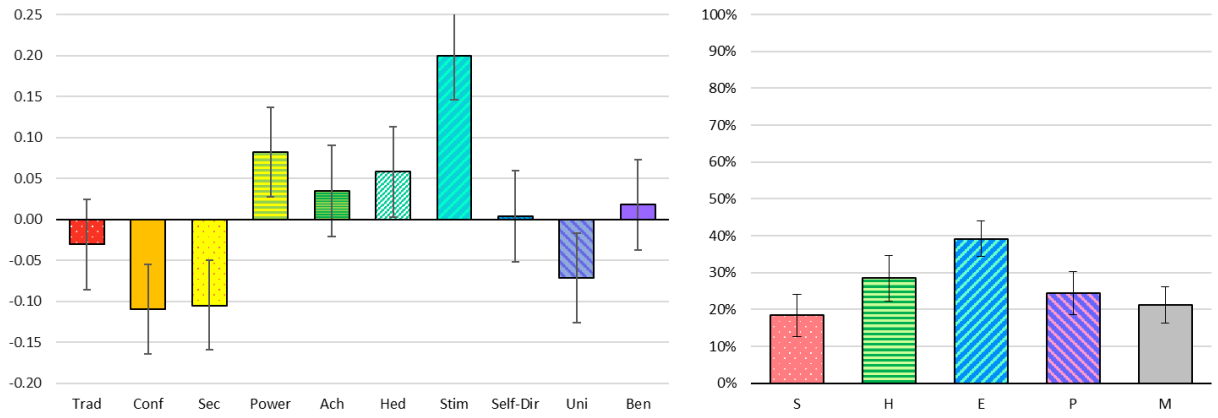


Fig. 5. Q2: Coin Toss – Values correlations and motivational type preferences for accepting chance of £200 gain at risk of £100 loss, *N*=1256. 95% confidence intervals shown.

As shown in fig. 5, a broadly sinusoidal pattern of correlations emerged in respect of Q2. There were negative correlations between conformity $r(1256) = -.11$, $p < .001$, security $r(1256) = -.11$, $p < .001$, and universalism $r(1256) = -.07$, $p = .011$ and a preparedness to risk losing £100 for the possibility of gaining £200 on the toss of a coin, and positive correlations for power $r = .08$, $p = .003$ and stimulation $r = .20$, $p < .001$. This translated to 39% of Explorers being prepared to accept this bet compared to 18% of Shepherds. In keeping with the circular relationships between values, the preferences of Hunters and Philosophers lay between these extremes at 29% and 24% respectively. 21% of Moderators accepted the bet. The difference between Explorers and Shepherds was $\chi^2 = 24.06$, 95% CI =0.28-0.13, $p < .001$.

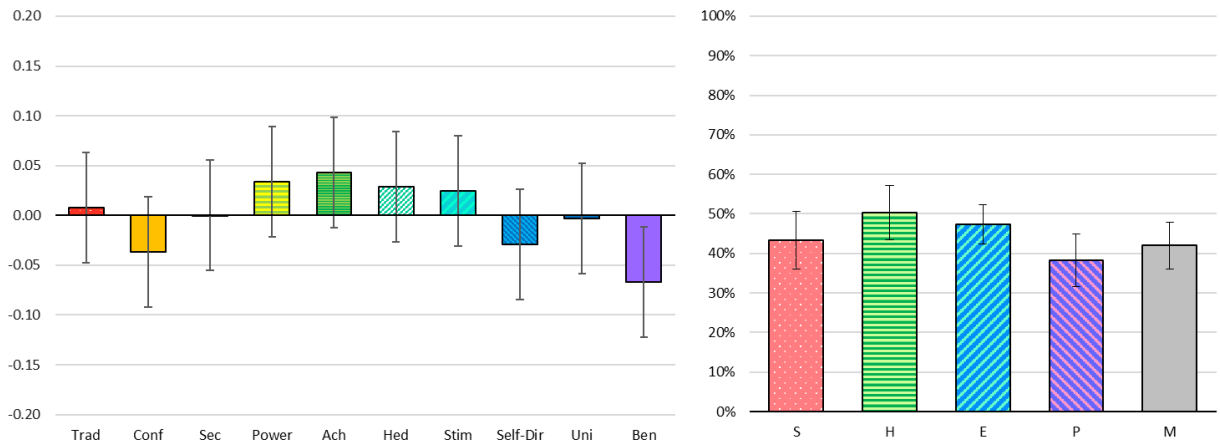


Fig. 6. Q3: Healthcare Budget – Values correlations and motivational type preferences for a 45% chance of saving all over the certainty of saving 30%, *N*=1254. 95% confidence intervals shown.

Fig. 6 shows a broadly sinusoidal pattern of correlations between values and whether to invest a healthcare budget in a treatment that will save 30% of lives, or in one that has a 45% chance of saving everyone and a 55% chance of saving no one. Only that for benevolence was statistically significant: $r(1254) = -.07$, $p = .017$. 50% of *N*=205 of Hunters and 47% of *N*=393 Explorers preferred a 45% chance of saving all, compared to just 38% of *N*=209 Philosophers: differences of $\chi^2 = 6.01$, 95% CI =0.21-0.02, $p = .014$, and $\chi^2 = 4.53$, 95% CI =0.17-0.01, $p = .033$, respectively.

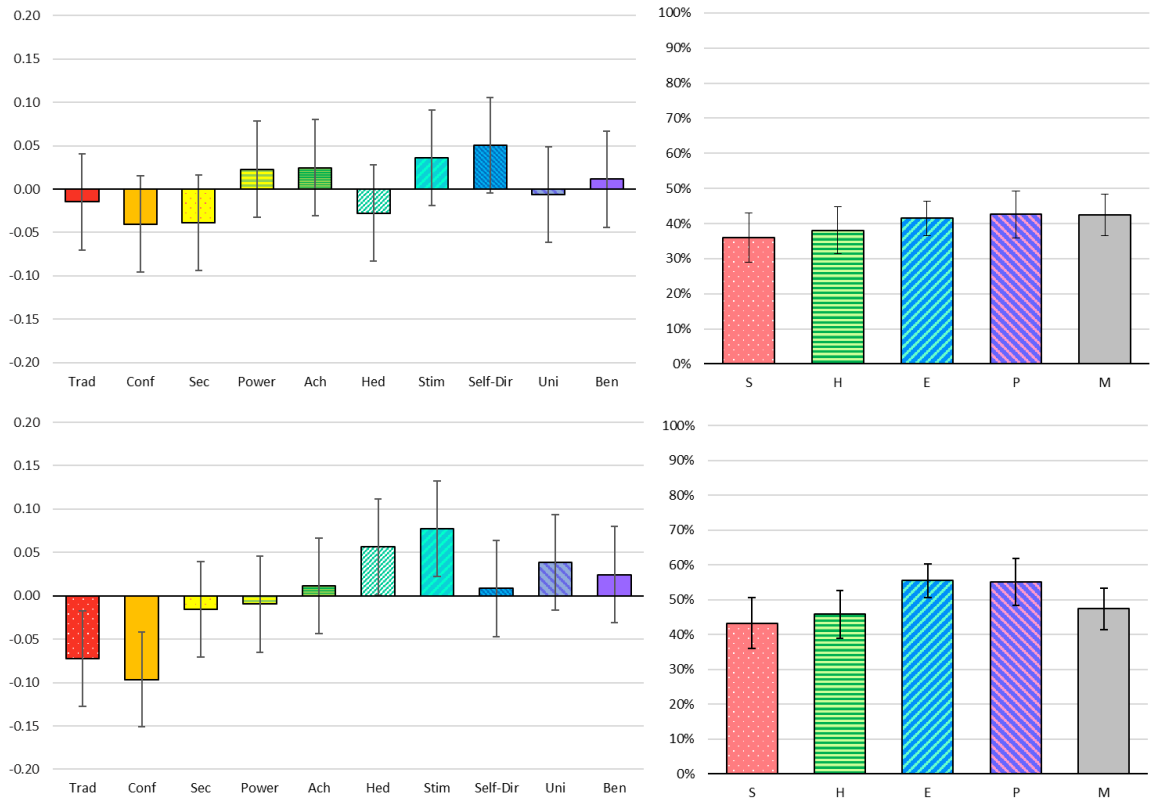


Fig. 7. Values correlations and motivational type preferences for Q4: (a) a 25% chance to gain £1,000 and a 75% chance of gaining nothing over £240 for certain, (above), and (b) then, a £25% chance to lose nothing and a 75% of losing £1,000 rather than taking a £750 loss for certain (below) *N*=1253. 95% confidence intervals shown.

As illustrated in fig. 7, in respect of Q4(a) and a preparedness to risk a certain £240 gain for a 25% chance to gain £1,000, there was no significant correlation with any value or difference between the types. A sinusoidal pattern of correlations between values and a preparedness to take a 75% risk of losing £1,000 to avoid a loss rather than accept a certain loss of £750 was found in respect of Q4(b). tradition and conformity exhibited negative correlations: $r(1253) = -.07$, $p = .010$, and $r(1253) = .10$, $p = .001$ respectively, while hedonism and stimulation exhibited significant positive correlations: $r(1253) = -.06$, $p = .046$, and $r(1253) = -.08$, $p = .006$ respectively.

The greater preparedness for risk-taking exhibited by Explorers and Philosophers over Shepherds and Hunters increased from Q4(a) to Q4(b), with 56% of *N*=393 Explorers and 55% of *N*=209 Philosophers prepared to accept a 75% risk of losing £1,000 for a 25% chance of escaping a £750 loss compared to 43% of *N*=178 Shepherds. The difference between Explorers and Shepherds being $\chi^2 = 7.32$, CI = 0.21-0.03, $p = .007$.

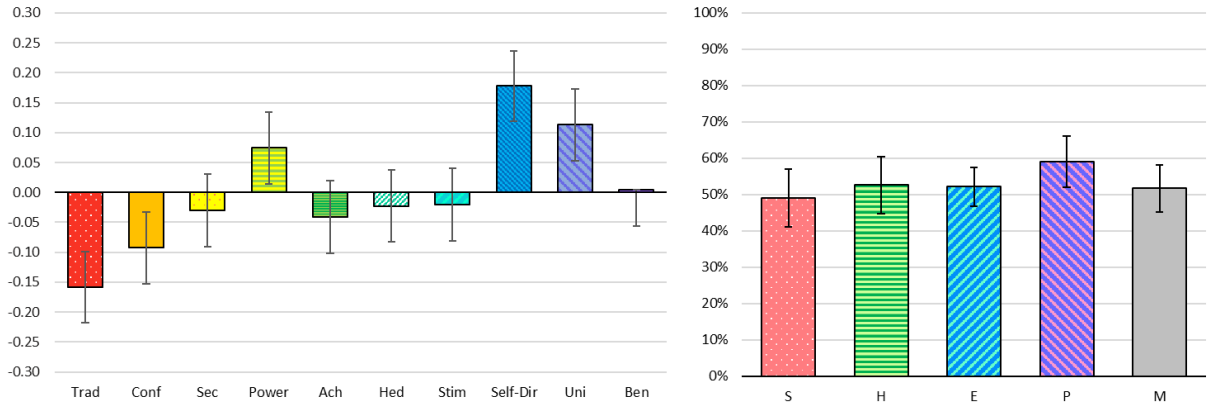


Fig. 8. Values correlations and motivational type for correct answers to Q5: 'If it takes 10 combine harvesters, etc.', *N*=1053. 95% confidence intervals shown.

As shown in fig. 8, tradition and conformity exhibited significant negative correlations of $r(1053) = -.16$, $p < .001$, and $r(1053) = .09$, $p = .002$ respectively, and self-direction and universalism exhibited significant positive correlations of $r(1053) = .18$, $p < .001$, and $r(1053) = .11$, $p < .001$ with answering Q5 correctly. These correlations translated to 59% of *N*=188 Philosophers (the most successful type)

answering correctly, compared to 49% of *N*=153 Shepherds (the least successful type), but the differences fell short of statistical significance.

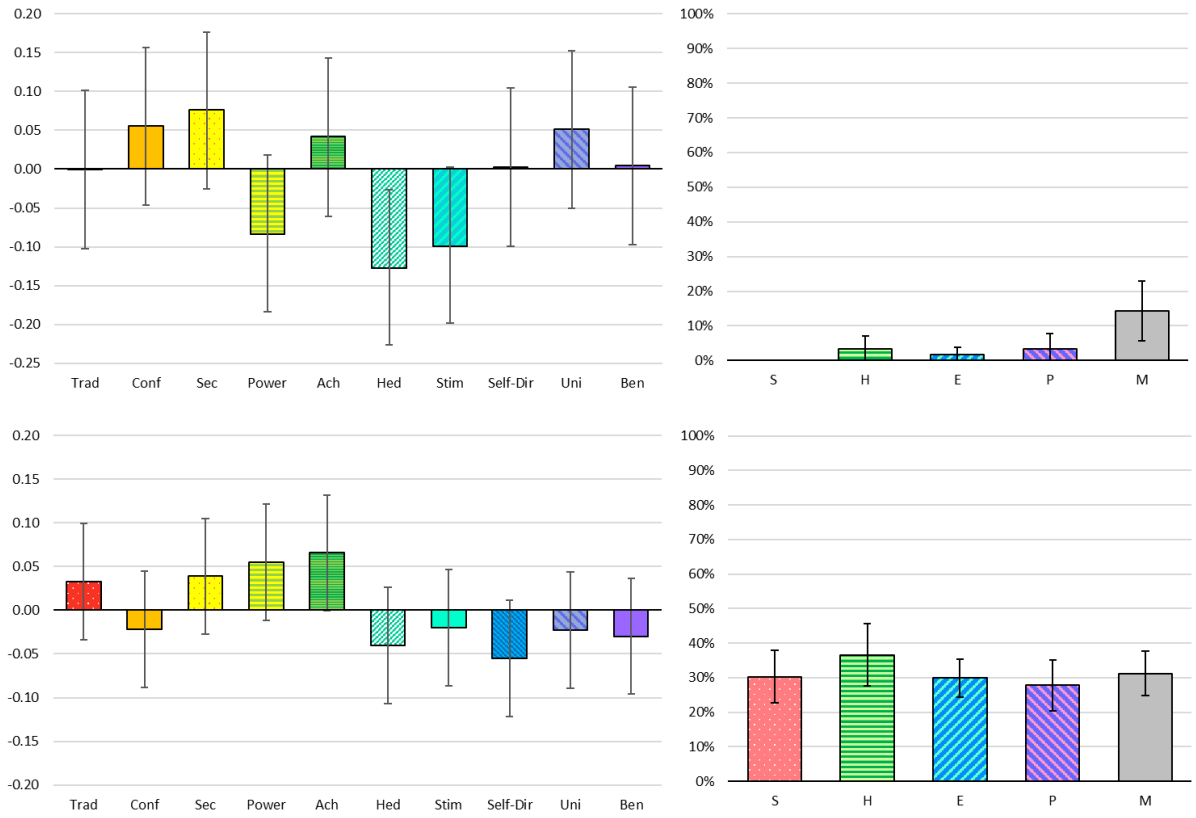


Fig. 9. Values correlations and motivational type for correct answers to Q6: Bayesian inference challenges: (i) chance of being infected, *N*=371 (above), and (ii) chance of correct identification, *N*=868 (below). 95% confidence intervals shown.

As reflected in fig. 9, only 5% of the *N*=371 participants answered Q6(i) correctly. Stimulation exhibited the largest (negative) correlation with correct answers: $r(371) = -.13$, $p = .014$. Moderators performed significantly better than other types, with 14% of *N*=64 answering correctly, compared to 2% of *N*=124 Explorers: $\chi^2 = 12.12$, CI =0.22-0.04, $p < .001$. When an alternative form of Bayesian inference challenge with three potential answers was presented in Q6(ii) the proportion of participants answering correctly rose to 31%, and a different pattern of correlations emerged, with achievement's positive correlation approaching significance: $r(868) = .07$, $p = .052$. It and three of the other values on the conservative half of the circle showed small positive correlations, while all

progressive values correlated negatively. Accordingly, 37% of *N*=112 Hunters answered correctly, compared to 28% of *N*=144 Philosophers, although the difference fell short of statistical significance.

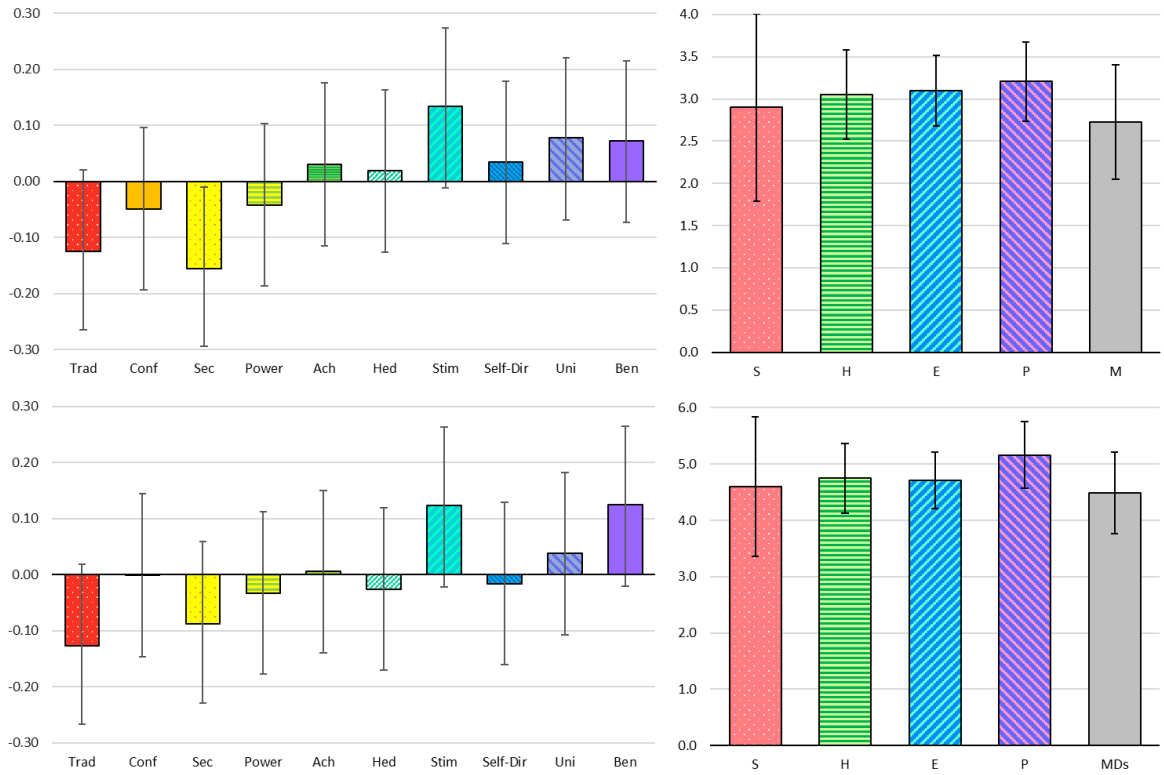


Fig. 10. Values correlations and motivational type for performance in Q7: the fluid intelligence test, over the first four puzzles (above) and in total (below) *N*=184. 95% confidence intervals shown.

Fig. 10 describes performance in respect of Q7. Performance after the first four puzzles was little different than what might have been anticipated had participants guessed randomly. Value correlations show a hierarchically tilted sinusoidal form. Over the first four puzzles tradition to power correlated negatively with correct answers, and those from achievement to benevolence correlated positively. The greatest negative correlation was for security: $r(184) = -.16$, $p = .04$, and the greatest positive correlation was for stimulation: $r(184) = .12$, $p = .07$. A sympathetic pattern of performance was observed in the motivational types, ranging from a mean of 2.9 correct answers for Shepherds (*N*=10) to 3.2 correct answers for Philosophers (*N*=44), in respect of the first four puzzles, exaggerated to 4.6 and 5.2 respectively over all ten puzzles, albeit the differences were not significant. Performance in the fluid intelligence test only correlated significantly with creativity as

expressed in response to Q8: $r(185) = .18$, $p = .02$, in respect of which post-hoc analysis revealed only one significant partial correlation between hedonism and Q7 scores: $r(184) = .18$, $p < .02$.

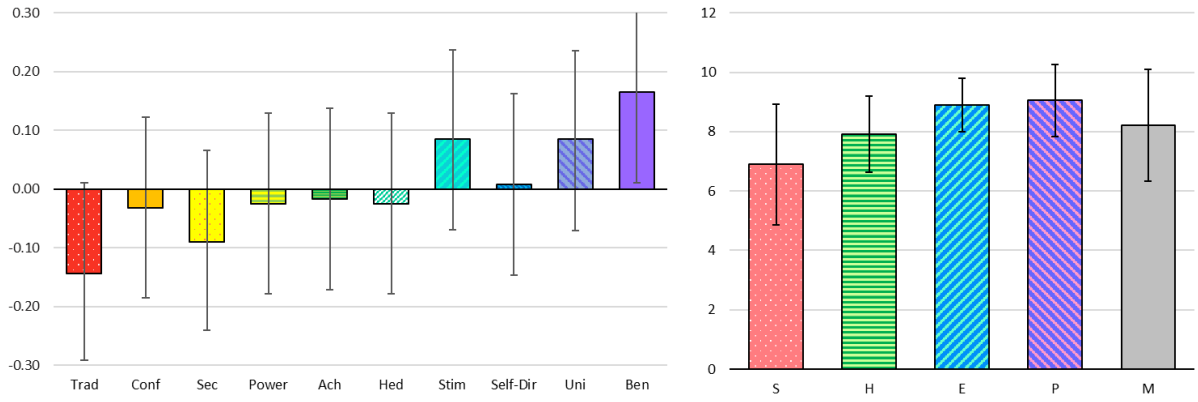


Fig. 11 Values correlations and motivational type for performance in Q8: How many uses can you think of for an empty plastic lemonade bottle (in two minutes)? *N*=163. 95% confidence intervals shown.

As shown in fig. 11 the creativity of participants in their performance in Q8 yielded a hierarchical pattern of correlations from tradition: $r(163) = -.14$, $p = .07$ to benevolence: $r(163) = .16$, $p = .04$. The was reflected in the average number of uses participants from each motivational type came up with, from $M = 9.1$, $SD = 3.84$ for Philosophers to $M=6.9$, $SD=3.28$ for Shepherds, $t(15.9) = 1.78$, $p = .09$, $d = 0.602$.

4. Discussion

Consistent with previous findings (e.g., Bardi & Schwartz, 2003; Doran, 2009) this study revealed circular/sinusoidal patterns of values-related decision-making biases (Q1, Q2, Q3 and Q6) and, consistent with theoretical expectations, combinations of circular and hierarchical influences (Q4, Q5 and Q7) and, in response to Q8, a purely hierarchical pattern. The patterns of personal risk-taking between the motivational types was broadly in line with theoretical expectations, in that Shepherds were the most risk averse, Explorers the least, and Hunters ranking between the two in respects of

Q1(ii), Q2 and Q4. For Q2 and Q4(a), the performance of the types followed the circle, with Philosophers being similarly risk-averse to Hunters. However, in respect of Q4(b) Philosophers and Explorers were the least risk-averse, being as likely to risk incurring additional losses as not. This suggests an ambivalence consistent with our evolutionary justification of Maslow's (1987) observations regarding the greater resourcefulness of self-actualizing individuals.

The expectation that Philosophers would be the most likely to give rationally supportable answers was met in respect of Q5, due to the significant positive contributions of self-direction and universalism. It is also possible to make a rational argument in support of their greater preference for guaranteeing the survival of 30% of the population in respect of Q3. This makes sense from a widely framed, self-transcending, tribal or genetic perspective, as it guarantees the survival of the tribe and its gene pool. The alternative – a 45% chance of saving all and a 55% chance of saving no one – only makes more sense from the perspective of a selfish individual, as it maximises the chances of personal survival yet is more likely to save no one.

The marginally superior performance of Philosophers and the apparent hierarchical influence of values in Q7 is consistent with the expectation that Philosophers would display the highest intelligence and Shepherds the lowest. However, the relatively small sample involved and the lack of statistically significant differences place limitations on what may be inferred from this result. The clearest evidence of a hierarchical pattern of influence was in respect of Q8, Guilford's (1967) Alternative Uses Test. The consistency of the pattern of value correlations and related motivational type performance suggest that statistically significant correlations and differences are likely to emerge if the exercise was repeated with a larger sample.

Given that the independent thought and action associated with self-direction are inextricably linked with intelligence and creativity, the comparatively small correlations between self-direction and success in Q7 and Q8 relative to those for the neighbouring values of stimulation and universalism are puzzling. It may be that these arise from discrepancies between self-evaluation and reality, and

from shortcomings in the way the systematic relationships between 'higher' and 'lower' values are accounted for. Evidence that such factors are at play would seem to be provided by the average Shepherd and Hunter profiles shown in fig. SM2. These show self-direction scoring higher than might have been expected given the trend of scoring in neighbouring values, suggesting a perceived influence at odds with the relative importance given to conformity and security.

Theoretical expectations concerning the greater potential for those most likely to be subject to values conflicts (i.e., Moderators) to respond rationally to propositions that invite erroneous intuitive responses, or involve delayed gratification, also seem to have been met. Because values exhibiting the greatest positive and negative correlations with responses to the various propositions were likely to be relatively less influential in the motivational systems of Moderators than they were to other types, one might have anticipated Moderators would perform close to the average of other types. However, Moderators most preferred the risky option with the higher equivalent value in Q4(a) and were among the most likely to wait a month for £5,500 rather than take £5,200 immediately in Q1(ii). Most striking was their superior performance in respect of Q6(i), where Moderators provided more correct answers than all other types combined, despite only representing 17% of the sub-sample responding to this question.

It is apparent the changes made to the Bayesian challenges of Q6, including replacing an open response with a multiple choice, improved the success rate for all types. However, given a 33% chance of guessing correctly in Q6(ii), only power- and achievement-driven Hunters improved upon this. Also, given only 37% of them answered correctly, their relative success was comparable to the 3% success rate they enjoyed in Q6(i); albeit that less than 33% of all the other types answered correctly. Given the Hunter values of power and achievement motivate individuals to be successful, advertise their abilities, and avoid being seen to fail, it may be that these values and the availability of multiple choices impacted on an intuitive cost-benefit analysis that better enabled them to justify the investment of resources in relatively costly rational analysis.

Evidence for the influence of values was found both in individual value scores and in the responses of differently motivated individuals. By accounting for the systemic interaction of values in individual motivational systems we found that relatively small, often statistically insignificant correlations between individual value scores and decisions concealed stronger, apparently values-driven influences. For example, over twice as many Explorers were prepared to risk losing £100 for a 50% chance of gaining £200 in Q2 as conservative Shepherds, despite no more than 4% of the variation in choices being attributable to any one value. Similarly, in respect of Q3, the apparently negligible contributions of self-direction and benevolence led Philosophers to be 28% more likely to prefer the certainty of saving 30% of people to a 45% chance of saving everyone than Hunters, who were most subject to the apparently negligible opposing influence of power and achievement. For Q6(ii), the relatively greater importance of security, power and achievement to Hunters seems to have been sufficient to enable them to outperform the average of the other types by a margin of 23%., despite these values being individually responsible for only tiny parts of the variation.

As was demonstrated by changing considerations of delayed gratification in Q1, and the presentation of Q6, values-related response sensitivity changes when variables are changed. Inevitably, when the disparity between options becomes too small or great there will tend to be agreement between decision-makers regardless of their values. However, between these limits the influence of values can be expected to vary. If variance is normally distributed, it is to be expected that the different value priorities of individuals will contribute to the greatest divergence of decision-making somewhere in the middle. It may be that future research will explore decision-making challenges that better investigate 'sweet spots' of maximum values-related variance.

5. Strengths, limitations, and directions for future research

Our findings illustrate how values influence decision-making in relation to challenges designed to test system 1 (Stanovich & West, 2000) intuitive biases (Kahneman, 2011), and propensities for engaging system 2, rational thought (Kahneman, 2011; Stanovich & West, 2000). They also point

toward how values affect rational capabilities. As such they advance our understanding of how values affect decision-making in real life.

Kahneman (2011) suggested that the type of risk-aversion exhibited in response to equivalents of Q2 could give rise to considerable opportunity costs if replicated in the decisions of many individuals in many organizations. Over many iterations, as might happen in large organizations, preferences for 'safe' options with equivalent values considerably lower than those of 'risky' options, comparable to refusing the bet offered in Q2, would eventually become the equivalent of refusing gifts with real values equal to the differences in these equivalent values (£50 in Q2). However, the questions we presented are perhaps too simplistic to be representative of real-life decision making. Organizational decision-makers are also subject to prescriptive guidelines and cultural pressures (e.g., Jabs, 2005; Weber et al., 2005) likely to be as influential as their values and other personal biases. For individuals, comparable decisions are likely to made in the light of other considerations salient to values, such as previous experiences, their impact on others, and how they will be viewed by others.

As with any self-reporting measure, the accuracy with which responses to the Schwartz (1992) questionnaire reflect the 'real values' of participants is uncertain. While removing data from some participants may have helped, it is likely spurious entries remained. Even genuine responses may be subject to imperfections in self-knowledge. The systematic nature of Schwartz's (1992) values enables us to review the likely influence of any one value with respect to others, which is what ascribing individuals to the adopted motivational typology sought to do. However, as the suggested restrictions on self-direction imposed by 'lower' values illustrates, a reliance on self-assessed value scores to determine motivational type is likely to be sub-optimal. In particular, allocational accuracy is most likely to be compromised when the margin by which values on the progressive half of the circle outscore those on the conservative half is small, because this may underestimate the restrictive influence of the 'lower' values. Given that the independent thought and action associated with self-direction are inextricably linked with intelligence and creativity, it seems likely the comparatively small correlations between self-direction and success in Q7 and Q8 relative to those

for the neighbouring values of stimulation and universalism reflect such shortcomings in measurement.

While referencing a west European norm group enabled us to compare individual motivational systems relative to a consistent benchmark, the difficulties associated with accurately assessing the relative influences of values in individual motivational systems are likely to be compounded by variations in the way different individuals, groups, and cultures represent their values. It may be possible to improve upon the coarse-grained findings we have made with appropriate controls and refinements, but neurological investigation may be required to gain a fine-grained understanding of people's values and their influence on decision-making.

It may be that values-related decision-making biases are more fully revealed in real life situations concerning propositions that are more ambiguous and complex, and in respect of which the consequences of decisions are real and the risks tangible. Indeed, given that organizations tend to foster cultures, and therefore individuals, sympathetic to the value priorities of their leaders (e.g., Hoffmann, et al., 2011), and the effects of consistent decision-making biases seem likely to be exaggerated and compounded when the challenges people face are contingent on the outcome of previous decisions, there would seem considerable potential for relatively small biases to have considerable compound effects. Large scale longitudinal research that analyses the responses of different motivational types to a range of comparable challenges that satisfy these criteria, in a variety of domestic and organizational settings, would help develop better understanding.

Budgetary constraints and a desire to make participation easier, and so expedite the gathering of data within time constraints, limited our ability to compare the relationship between intelligence, values, and decision-making. Research to analyse the performance of much larger samples with respect to a variety of measures of intelligence would shed further light on the apparent hierarchical relationship between values and intelligence, and their distinctive influences.

6. Conclusion

Our findings suggest that values may play a more extensive role in decision-making than previously thought. In addition to the circular pattern of correlations between values and decision-making biases usually associated with the Schwartz (1992) system, there is evidence to suggest coexistent linear correlations consistent with XXXXX, et al's (2021) proposed evolutionary hierarchy. This superimposes developmental influences attributable to the evolution of the increasingly complex systems of humanity: from the simple conservation of energy in its most fundamental components and antecedents, to the intelligent self-regulation of the CAS it has become. Additionally, the evidence suggesting individuals most likely to be prone to experiencing values conflicts are more likely to make decisions that fit neither with circular nor linear hierarchical patterns of correlations, and points toward values playing an important role in mediating between systems 1 and 2 thinking (Stanovich & West, 2000). Taken together these findings invite further investigation, and perhaps a reappraisal, of the role values play in guiding personal decision-making, and, when considered collectively and systematically, in shaping society.

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