Social Propensities

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Abstract: We offer a theory and methodology for studying what we call social propensities. A social propensity consists of a social value rule (e.g., MaxOwn, MinDiff, Need) combined with a propensity function (monotonic or non-monotonic) that expresses the rule as a probability of endorsement for a given self:outcome pair. Our approach formalizes and generalizes concepts from interdependence theory, social value orientations, and distributive justice rules, and is applicable in two-person games and exchange situations.

In this paper, we present a theory and methodology for studying what we call *social propensities*. These are a generalization and integration of some existing models in two research traditions, interdependence theory (Kelley & Thibaut, 1978; Kelley et al., 2003) and distributive justice theory (e.g., Deutsch, 1975; Fiske, 1991). Our approach includes a formalization of what psychologists call "social value orientations" (SVO) and is related to what economics call "other-regarding utility functions." Unlike the SVO approach, our approach is intended to allow researchers to infer these orientations in from choices made in any situation in which payoffs to self and other vary, without requiring a standardized choice questionnaire. But the approach makes explicit how situations (including those modeled in SVO questionnaires) vary in their coverage of the relevant parameter space, especially those regions that would enable the researcher to distinguish among specific forms of social propensities.

In step with early developments in SVO research, sociolegal scholars have long noted the relevance of interdependence theory concepts to core concerns of both procedural and substantive areas of law (see Hollander-Bluoff, 2017; Jurow, 1971; Lewinsohn-Zamir, 1998; Tyler 2003). Recently, empirical legal scholars have begun to incorporate SVO measurement methods into experimental studies of judicial decision-making and property rights (Bar-Gill & Engel 2016; Engel & Zhurakhovska 2017).

BACKGROUND

Social Value Orientations (SVO) are part of a theoretical framework for characterizing interpersonal behavior developed by social psychologists over several decades from the 1960s to the present (e.g., Griesinger & Livingston, 1973; Kelley & Thibaut, 1978; Liebrand & McClintock, 1988; Messick & McClintock, 1968; McClintock, 1972; McClintock, Messick, Kuhlman, & Campos, 1973; Murphy & Ackerman, 2013; Van Lange, 1999). It is part of the social exchange theory tradition – and more specifically, *interdependence theory* (Kelley & Thibaut, 1978; Kelley et al., 2003), which is essentially a psychological adaption of game theory. Many of the ideas were defined, formalized, and experimentall tested well before the more recent explosion of *behavioral game theory* work in economics and other fields (e.g., Camerer, 2003; Charness & Rabin, 2002; Falk & Fischbacher, 2006; Fehr & Schmidt, 1999).

A key tenet of interdependence theory is the distinction between a *given matrix* of objective outcomes and a *transformed matrix* which reflects the relative value the actor places on outcomes for Self and Other (Kelley & Thibaut, 1978). Thus, people often depart from equilibrium rational choice predictions of a given game structure because they are essentially playing a different game (see McAdams, 2009)..

As an illustration, here the "given matrix" for a prisoner's dilemma situation. where the rational-choice equilibrium is the suboptimal defect-defect {4,4} outcome:

	$o_{cooperate}$	o_{defect}
$s_{cooperate}$	$\{8, 8\}$	$\{0, 12\}$
s_{defect}	$\{12, 0\}$	$\{4, 4\}$

After applying a MaxJoint transformation: $\hat{s} = s + o$, $\hat{o} = s + o$, the "Effective Matrix" now has an equilibrium at the optimal cooperate-cooperate outcome{16,16}:

$$\begin{array}{ccc} & o_{cooperate} & o_{defect} \\ s_{cooperate} & \{16,16\} & \{12,12\} \\ s_{defect} & \{12,12\} & \{8,8\} \end{array}$$

An actor's valuation of outcomes for Self and Other can be represented by a circumplex structure defined by two axes, Self outcomes and Other outcomes (Griesinger, & Livingston, 1973). Note that a circumplex structure is different than a simple 2-dimensional space; it implies equal maximum vector lengths in all directions, as well as a precise set of ordinal predictions about the correlations among points in the structure (Wiggins, 1980). Here is the basic *Social Value Orientation* circumplex, depicted with the trait adjectives that are common in the more recent literature.

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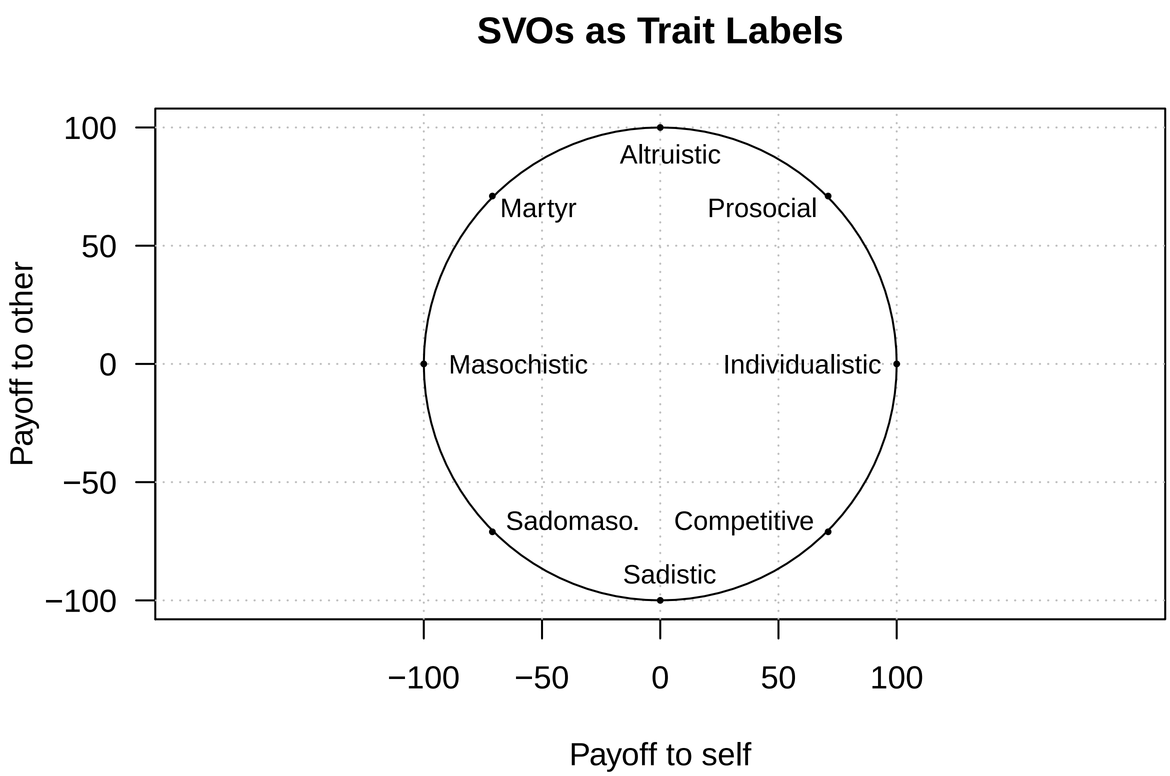
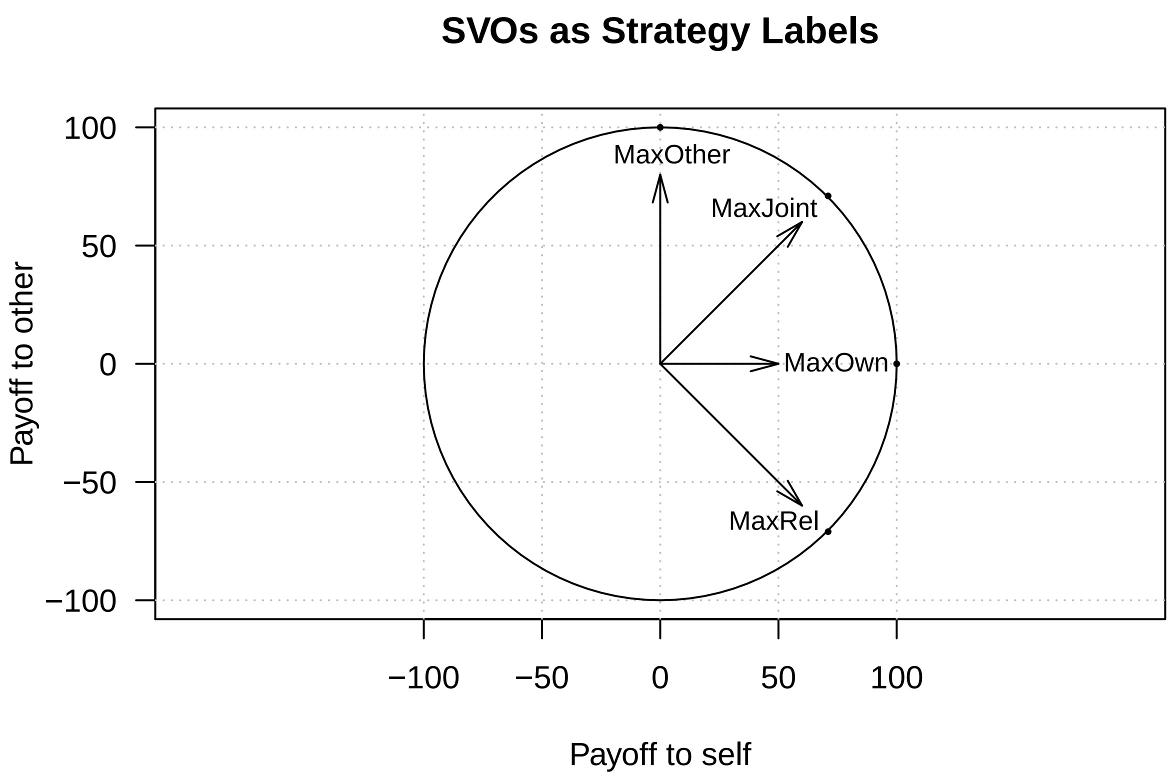


While it emerged from the social exchange theory tradition, psychologists (e.g., Wiggins, 1980) have long noted the close parellels between this trait circumplex and an "interpersonal circumplex" first proposed by Timothy Leary (1959) – prior to his second career as a psychedelics advocate. The interpersonal cicumplex organizes interpersonal traits around a structure conventionally oriented by orthogonal axes often called "agency" and "communion" (Abele & Wojciszke, 2014), which – if appropriately rotated – turn out to map onto the "extraversion and"agreeableness" dimensions of the fundamental "Big Five" system of personality traits (e.g., Answell & Pincus, 2004; DeYoung et al., 2012).

As sociolegal scholars, our interest is primarily in "states" – the momentary interplay of personal goals and preferences with situational affordances – rather than traits. Also, a drawback of the trait labels is that adjectives like "Prosocial" can have many different connotations, not all of which correspond to the SVO framework. We prefer the original terminology used by Messick and McClintock (1968; Kelley & Thibaut, 1978; McClintock, 1972), which refers to *strategies* (or operations) rather than traits. Thus, there are many ways to be prosocial, but MaxJoint specifically refers to a strategy of equal-weighting of outcomes for Self and Other.



Strengths and Limitations of Existing Measures of "Social Value Orientation"

An ideal measurement method for assessing social preferences would be both readily mathematically modeled and cover the full range of preferences on the Social Value Circumplex (see Murphy and Ackerman, 2013). To date one popular measure of SVO produces output which can be modeled and so permits utility model fitting analyis, the *SVO Slider Measure* (Ackermann & Murphy, 2013). This makes possible the comparison of results with conceptually related work in experimental economics. Yet the Slider Measure captures only the most common social preferences and compresses their placement on the Cartesian coordinate system. The full Social Value Circumplex is represented in the output produced by the *Ring Measure* (Liebrand, 1988). For both the SVO Slider Measure and the Ring Measure, payoffs for self are set along the x-axis and payoffs for the other are set along the y-axis. The Ring Measure allows for negative allocations by setting a (0,0) center point, unlike the SVO Slider Measure which is centered at positive payoffs (50,50) for both self and other. The Ring Measure is capable of identifying both the magnitude and direction of a decision maker's social preferences. It does not distinguish between inequality aversion and joint payoff maximization preferences, however, an advantage of the Slider Measure. The most commonly used measure of social preferences, the 9-item *Triple Dominance Measure* (Van Lange et al., 1997) cannot disambiguate inequality aversion from joint payoff maximization, nor does it represent the full circumplex, but it does capture the most frequent social preferences (prosocial, individualistic, competitive) with a set of allocation options that can be completed quickly by study participants.

Another limitation of the social value orientation approach is that (with the partial exception of the MinDiff or equality rule) it is largely disconnected from the rich interdisciplinary literature on distributive justice, with a veritable bestiary of possible rules for allocation (equity, equality, need, first-come-first-served, Pareto, Rawls, and so on).

Thus we sought a new approach that would build on these traditions but permit better measurement, greater formalization, and better theoretical articulation and integration.

Social Propensities

Building on these foundations, our basic thesis is that people have a suite of internalized rules for how to allocate outcomes to Self and Other – rules that are often in conflict. (For examples of such rules, see Deutsch, 1975; Leventhal, 1976. For a cognitive analysis of rule conflicts, see Holland, Holyoak, Nisbett, & Thagard, 1986.) Our account is agnostic about the extent to which these rules are "pre-wired" products of evolution vs. aquired products of learning or reasoning.

Each of these *social value rules* is paired with an appropriate *propensity function* which yields the probability of endorsing any given choice between allocations to self and other. Social propensities have the following properties.

1. Choice is *stochastic*, because perceptions of the situation as well as individual determinants of choice are noisy. The stochastic aspect of choice is operationalized by our logistic propensity functions, described below.
2. Choice is *fuzzy* because irrespective of noise, preferences can be vague or they can be precise and well-articulated. The fuzzy aspect of choice is operationalized our *clarity* parameter (also see MacCoun, 2012, 2017), described below.
3. The propensity space is completely specified for a given rule, in the sense that there is a predicted probability of endorsement for every self-other pair of outcomes.

Propensity Functions

Propensity functions can be either *binomial* (referring to the probability of endorsing a single self-other outcome pair) or *multinomial* (referring to the probability of choosing one pair over a given alternative pair. They can be either *monotonic* (a consistently increasing or decreasing function of a given rule) or *non-monotonic* (single-peaked or ideal point). And non-monotonic propensities can be defined with respect to different distance metrics; e.g., *euclidean* (a function of the squared difference between self and other outcomes) vs. *city block* (or Manhattan; a function of the absolute difference between self and other outcomes). The Euclidean metric is tolerant of small differences but exaggerates large differences; the city block metric penalizes even small differences. Here is the binomial, monotonic function:

$$\phi_1\left(v\right) = \frac{m}{1 + exp(-v)}$$

Here is the multinomial, monotonic function:

$$\Phi_1\left(v\right) = \frac{m}{\sum exp(-cv_i)}$$

Here are the binomial, non-monotonic functions with city-block and Euclidean metrics, respectively:

$$\phi_2\left(v\right) = \frac{2m}{1 + exp(c\left|v\right|)}$$

$$\phi_3\left(v\right) = \frac{2m}{1 + exp(cv^2)}$$

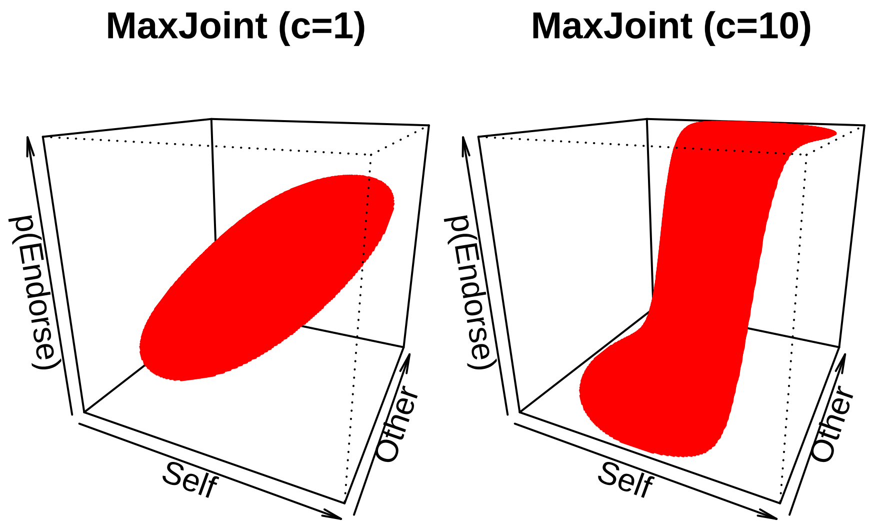
Here are the multinomial, non-monotonic functions with city-block and Euclidean metrics, respectively:

$$\Phi_2\left(v\right) = \frac{m}{\sum exp(c\left|v_i\right|)}$$

$$\Phi_3\left(v\right) = \frac{m}{\sum exp(cv_i{}^2)}$$

As noted above, each of our propensity functions has a *clarity* parameter (c; see MacCoun, 2012) that allows them to range from strict, deterministic step functions to fuzzy or stochastic functions. For parsimony, clarity can be set to a fixed value; alternatively, it can be treated as a free parameter to be estimated. The latter approach can be seen as a "fudge factor" to improve fit, but we think it is more constructively viewed as a characteristic of situations to be estimated and studied.

Below, we illustrated the effects of clarity for one rule, MaxJoint. Note that when clarity increases, the social propensity becomes more and more like a discrete social rule or behavioral policy.



Propensity Rules

The particular rules that are invoked will be a function of stable personal dispositions, the characteristics of the Other, the nature of the relationship (e.g., business associates, parent and child), the task, and the situational context. Later, we sketch out how multiple rules might get combined in a constraint satisfaction network, which can be approximated by a simple weighted average process.

Elementary Social Value Rules

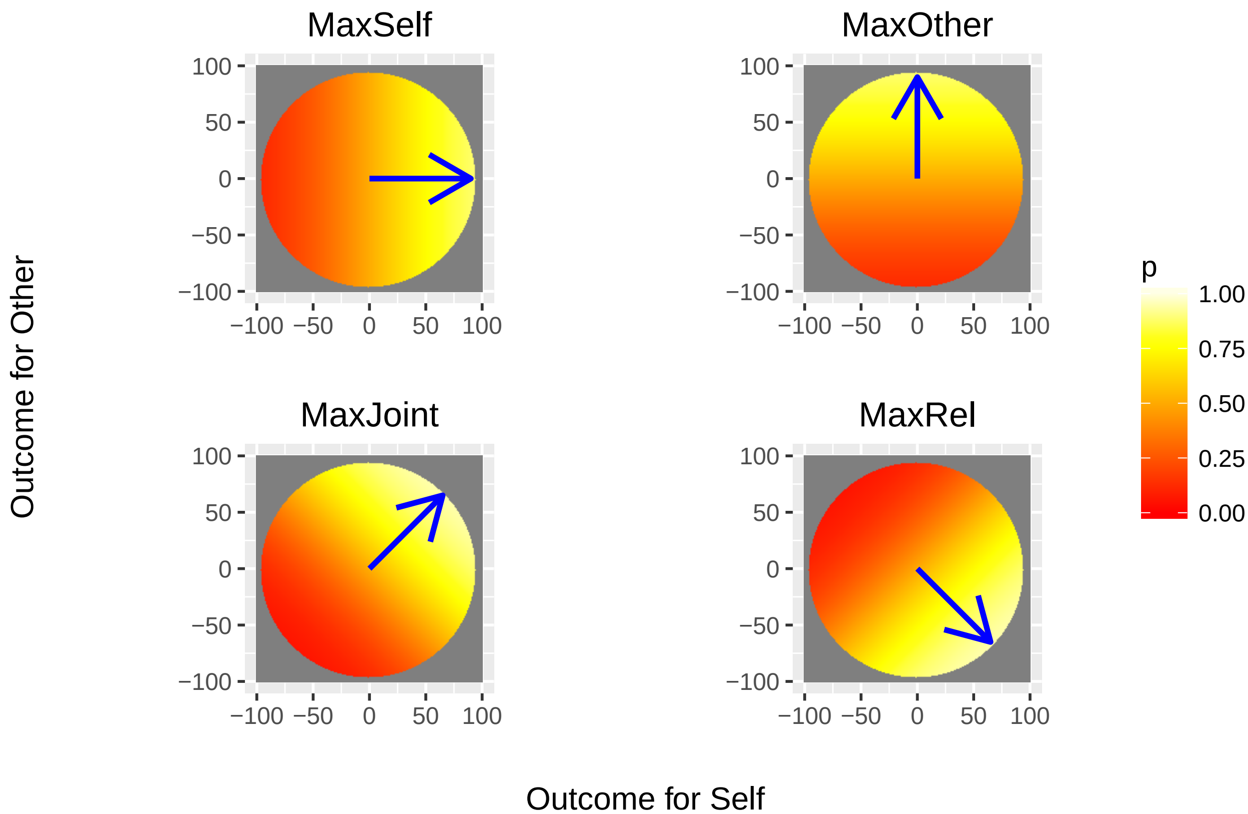
Our first set of rules are taken directly from the interdependence theory tradition (Messick & McClintock, 1968; Kelley & Thibaut, 1978). Note that all of these rules are monotonic.

Table 1: Elementary Social Value Rules

Name	v	Prop.Func.
MaxSelf	s	$\phi_1(v)$
MaxOther	o	$\phi_1(v)$
MaxJoint	$s+o$	$\phi_1(v)$
MaxRel	$s-o$	$\phi_1(v)$

These rules are defined solely by the prospective outcomes to Self and Other. Under *MaxSelf*, actors display pure individual self-interest, giving gives no weight to others' outcomes. Under *MaxOther*, actors display pure altruism, giving no weight to own outcomes. Under *MaxJoint*, equal weight is given to own and other's outcomes. This is sometimes confusingly called "cooperative" or "prosocial" which is unfortunate because those terms can have other meanings. Finally, under *MaxRel*, the actor chooses the pair of outcomes that maximizes own outcome relative to other's outcome; this is sometimes called "competitive", but again, MaxRel seems more precise.

The predictions of these initial rules are fairly simple, but it is useful to visualize them as contour plots, which will facilitate comparison to more complex rules to follow.



Distributive Justice Rules

Thus far, our approach is mostly a more complex formalization of existing "social value orientation" schemes (see below for illustrations). But while we value formalization, our major motivations are integration and generalization.

Thus, our next set of rules show how commonly studied principles of distributive justice (Deutsch, 1975; Leventhal, 1976; Walster, Walster, & Berscheid, 1976) can be cast in the same framework.

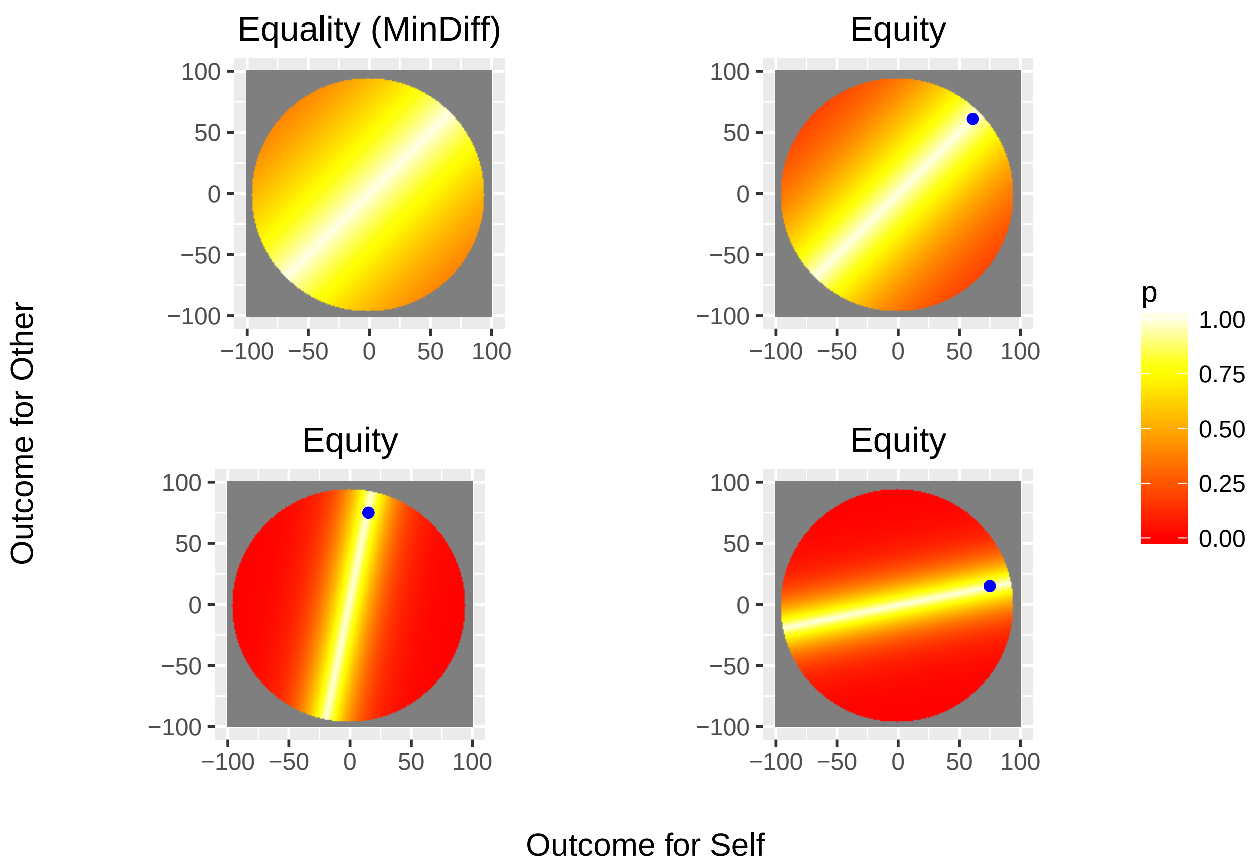
The equality rule is sometimes called "inequality aversion" and in the social value orientation tradition is sometimes labeled the "MinDif" strategy. What psychologists call "equity" is the notion that outcomes should be proportional to inputs or contributions ("inequity aversion"). Because the basic equity formulation can lead to occasional anomalies, the expression below might be modified various more complex formulations (see Moschetti,1979). Finally, there are several different ways one might operationalize allocation by "need".

Note that most of these rules require a *reference point*. Specifically, for the Equity rule, (s_C, o_C) is *contribution point*. And for the Need rules, (s_0, o_0) represents the *current state* or status quo.

Below, we plot the equality and equity rules.

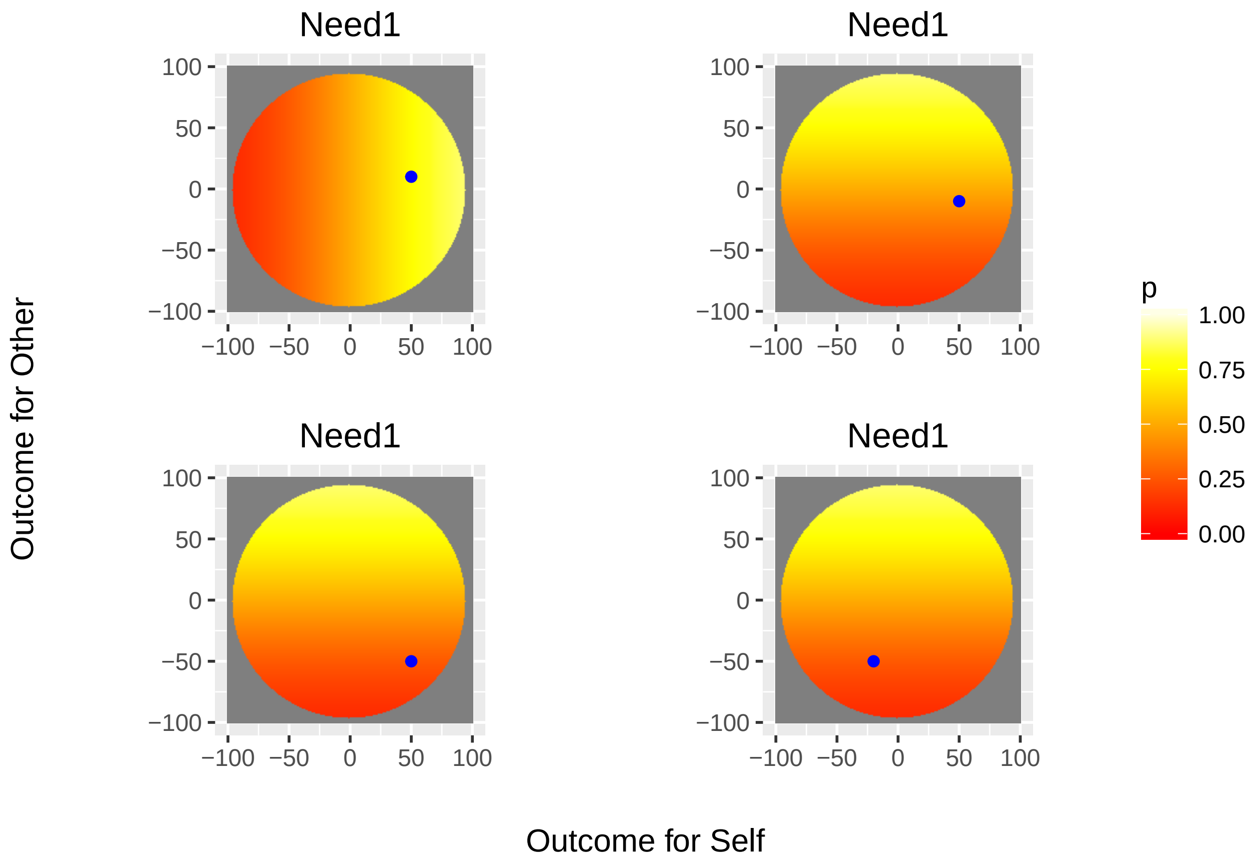
Table 2: Distributive Justice Rules

Name	v	Condition	Prop.Func.
Equality	$\lvert s-o \rvert$	none	$\phi_2(v)$
Equity	$\left\lvert \frac{s}{s_C} - \frac{o}{o_C} \right\rvert$	$s_C, o_C > 0$	$\phi_2(v)$
Need1	o	$o_0 < 0$	$\phi_1(x)$
Need2	$(1-\lvert o_0 \rvert)\, s + \lvert o_0 \rvert\, o$	$o_0 < 0$	$\phi_1(v)$
Need3	$(1-\lvert o_0 - s_0 \rvert)\, s + \lvert o_0 - s_0 \rvert\, o$	$o_0 < 0$	$\phi_1(v)$



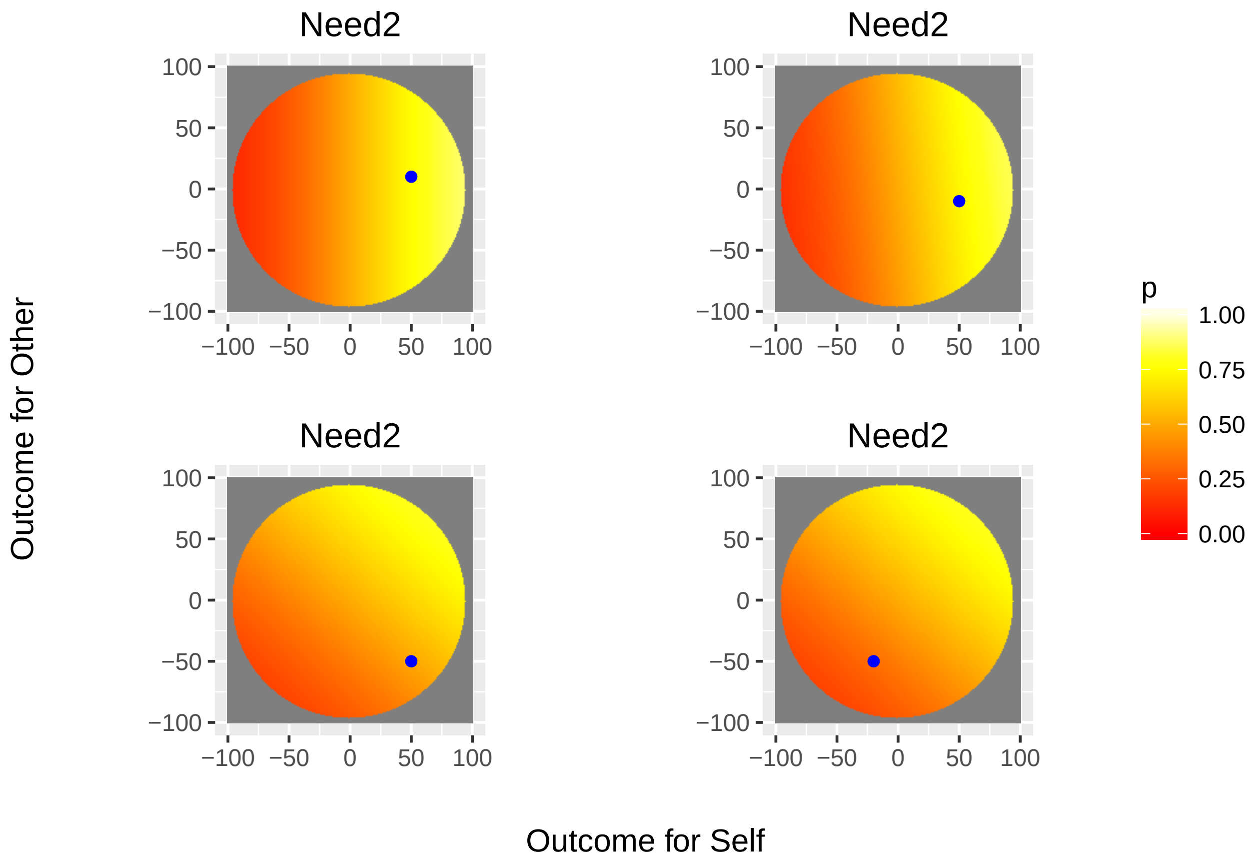
Note that for the Equity rule, the blue dot depicts the relative contributions of each party. Notice that the equity rule is essentially a *rotation* of the equality rule.

Below, we plot the Need1 rule – MaxSelf, but MaxOther if Other's state < 0 – for four different initial states.

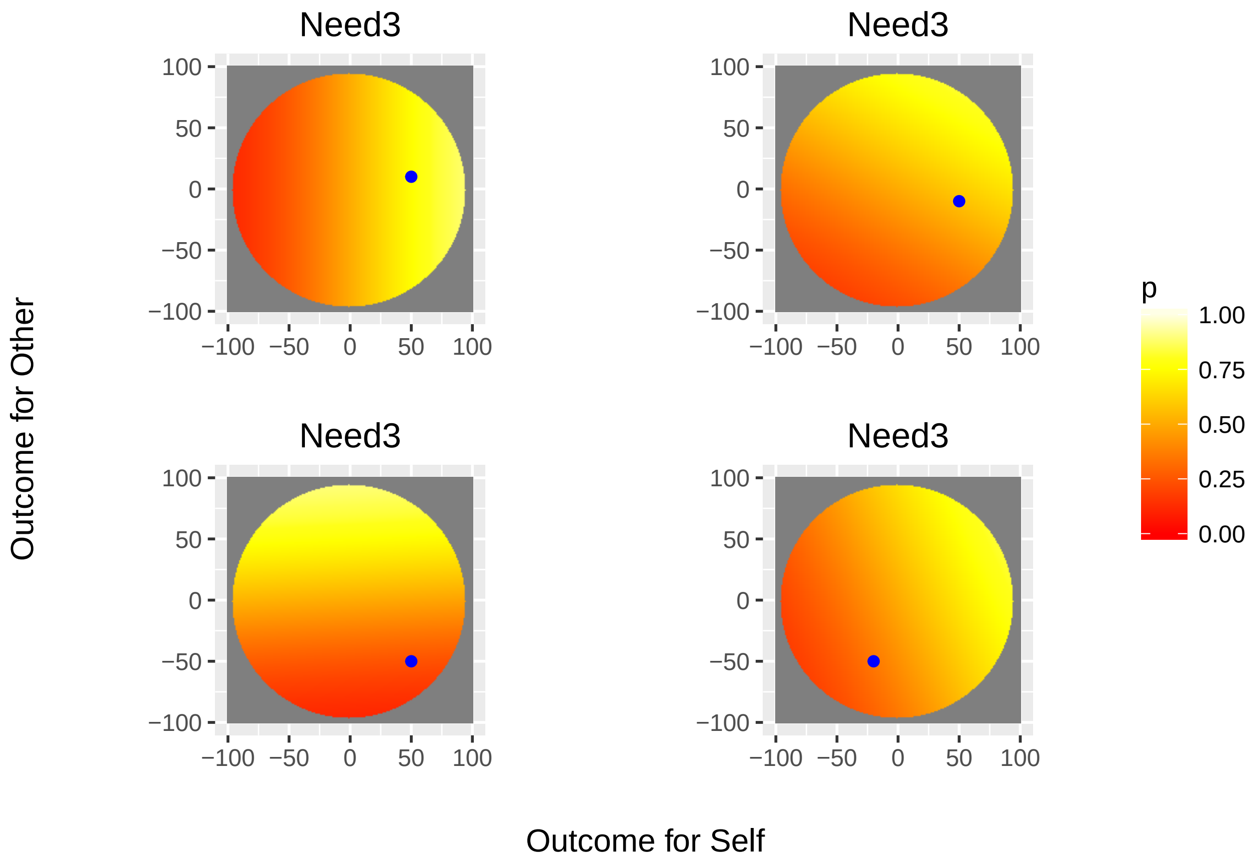


Note that for the Need rule, the blue dot depicts the current state (status quo).

Below, we plot the Need2 rule – MaxOther as function of other's need – for four different initial states.



Finally, below, we plot Need3 – MaxOther as function of other's need minus own need – for four different initial states.



Empirical Strategies for Applying the Theory

Empirically, our framework can be applied for measurement, for prediction, and for interpretation.

This can be done most powerfully in controlled experiments, where participants (of varying characteristics and relationships) can be randomly assigned to different outcome pairs, contribution points, and/or current states. But the method can also be used to estimate social propensities in any situation in which potential outcomes for self and other vary.

In either type of study, we believe there three basic strategies for characterizing social propensities.

Strategy 1: Model Matching

One approach is to offer pairs of choices, observe which choices are endorsed, and then compare them to predictions generated by each rule (for a given level of clarity).

We can illustrate this approach using data provided by Murphy, Ackerman, and Handgraaf (2011; also see Murphy & Ackerman, 2013), who collected social value orientation data for a common set of 56 participants using three different standardized instruments, their own "SVO slider task," the Triple-Dominance Measure (see Van Lange et al., 1997) and the Ring Measure (Liebrand, 1984). We use their slider data from their 2nd experimental session, but find similar results for their 3rd session.

Below, we compare the proportion of respondents best matching each of five social value strategies, as categorized by Murphy et al., and as categorized using our approach. Specifically, we fixed clarity at 25, generated predictions for each rule and each pair of points, and then categorized respondents by the best fitting rule across their choices.

Measure	Source	MaxSelf	MaxOth	MaxJoint	MaxRel	MinDiff
Sliders	Murphy et al.	0.34	0.00	0.64	0.02	na
Sliders	Our method	0.34	0.00	0.61	0.46	0.05
Triple Dominance	Murphy et al.	0.32	0.00	0.61	0.03	na
Triple Dominance	Our method	0.34	0.00	0.63	0.03	0.0
Ring	Murphy et al.	0.58	0.00	0.36	0.04	na
Ring	Our method	0.55	0.04	0.38	0.04	na

Our method is in close agreement with the categorizations provided by Murphy and colleagues.

One notable difference is that our method distinguishes between two different forms of prosociality – MaxJoint vs. MinDiff (equality), at least for the Slider and Triple Dominance tasks, which enable these two strategies to be distinguished. On the other hand, we should clarify that under our method, MaxOth and MaxJoint were equally likely using the Triple Dominance method. Finally, under either method of categorization, the Ring measure produces a distribution of strategies that differs considerably from the Slider and Triple Dominance tasks.

The Murphy et al. datasets illustrate the aforementioned weakness of these standardized methods: Each of the instruments provides only partial coverage of the full circumplex. But our approach does not require standardized instrument; it simply requires observed choices among known outcome pairs on a common metric of value (e.g., points, cookies, dollars). Still, we appreciate the problem the authors of these instruments were trying to solve: providing a standardized set of choices does facilitate interpersonal comparisons of choice strategies. That is an essential psychometric goal under a trait conceptualization. But our method might help to operationalize strategies in real-world choices, with the caveat that the observed patterns will reflect a mix of trait, relationship, and situational variance.

Strategy 2: Rule Hybrids

We have already claimed that people have many different rules available to assess and respond to a situation – including rules that are in conflict.

This implies that more than one rule may influence choices.

In principle, we can see several plausible ways of combining rules:

- Lexical: When two rules are in conflict, the actor always prioritizes one rule over another.
- Weighted averaging: The propensity is the average of the predictons under each applicable rule, perhaps weighted by their importance.
- Multiplication: The probability of endorsing a given option is the product of the propensitiees under different rules. Since propensities are on a 0-1 unit metric, this is the same as averaging when the rules agree, but each rule has "veto power" when they disagree (since a prediction of p=0 is an absorbing state).

We are ambivalent about rule hybrids. On the one hand, they seem highly plausible from a psychological perspective, and may well describe choice behavior. On the other hand, these hybrid rules allow so many possibilities that it seems doubtful they can be empirically distinguished from each other.

Strategy 3: Goal Criteria Estimation

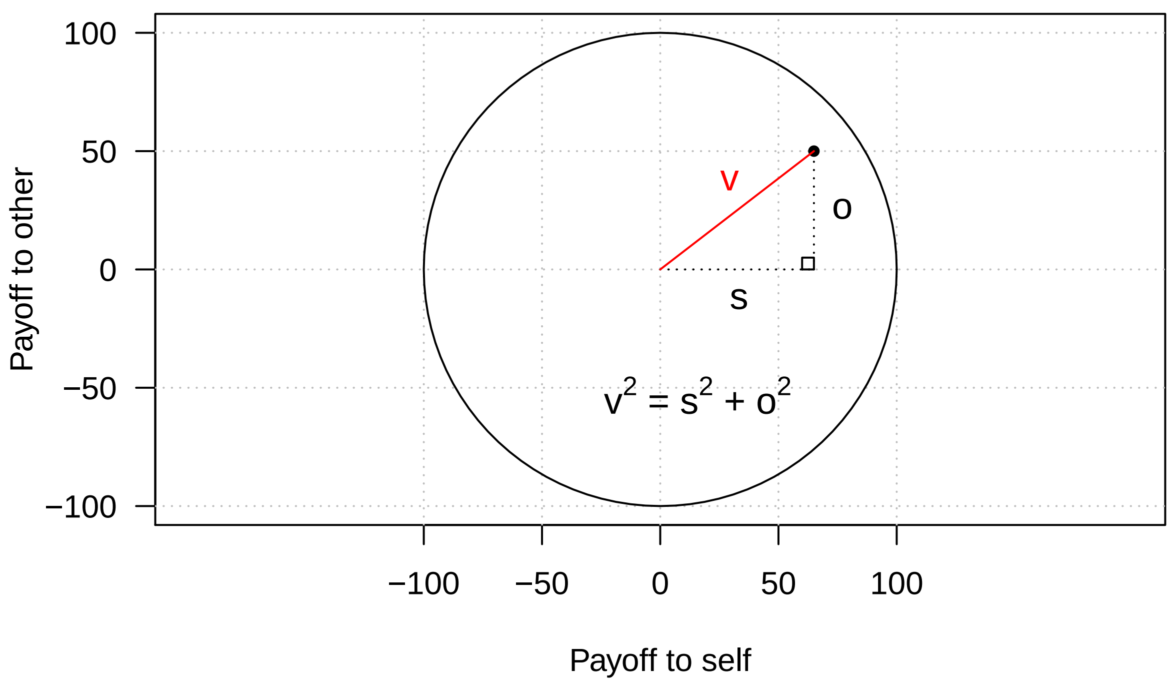
Since many different rule hybrids might yield the same profile of choices, we believe it is more parsimonious to simply identify the "Ideal Point" in the circumplex region that would make the observed profile of choices most likely.

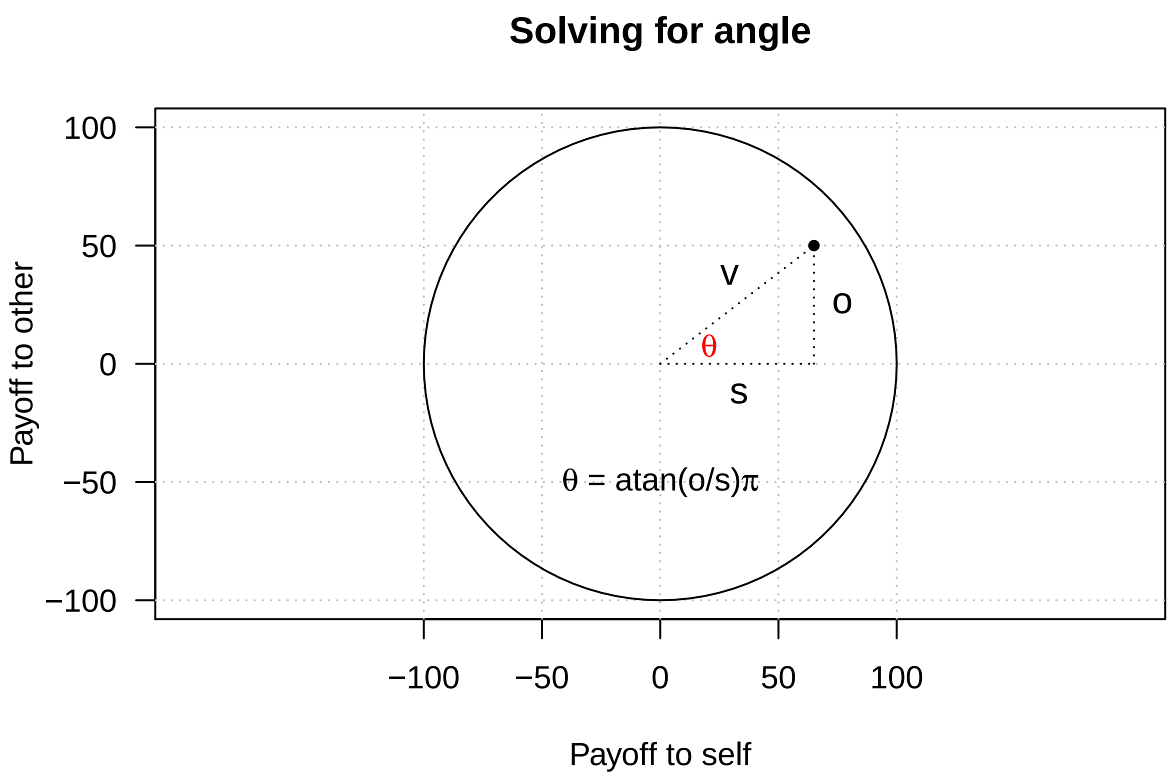
Following Griesinger and Livingston (1973) and Liebrand, and McClintock (1988), we can give the circumplex a trigonometric interpretation. Given outcomes for Self and Other, it is possible to compute a *vector length* using the Pythagorean Theorem, and to compute the angle, θ, corresponding to the relevant SVO, using the arctangent ($atan$ or tan^{-1}) function, which gives the angle in radians (360 degrees = 2π radians).

$$v = \sqrt{s^2 + o^2}$$

$$\theta = atan\left(\frac{o}{s}\right)$$

Solving for vector length

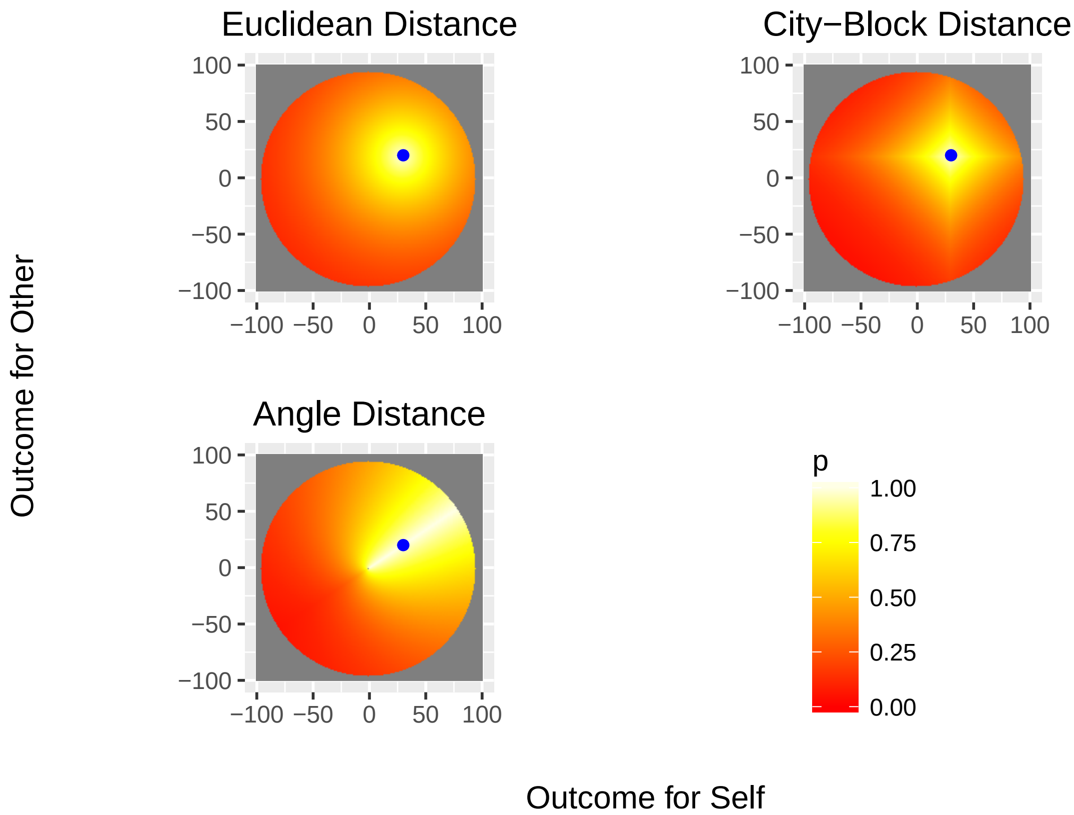




These principles suggest possible candidates for Ideal Point Rules, involving two kinds of goal criteria: *ideal point* $(\hat{s}, \hat{o})$ or *ideal angle* $\left(\hat{\theta}\right)$.

Table 4: Ideal-Point Rules

Name	v	Prop.Func.
CityBlock	$\lvert s-\hat{s}\rvert + \lvert o-\hat{o}\rvert$	$\phi_2(v)$
Euclidean	$(s-\hat{s})^2 + \lvert s-\hat{s})^2$	$\phi_2(v)$
Angular	$\left\{\begin{matrix} \left\lvert\theta-\hat{\theta}\right\rvert & when \left\lvert\theta-\hat{\theta}\right\rvert \leq \pi \\ 2\pi - \left\lvert\theta-\hat{\theta}\right\rvert & when \left\lvert\theta-\hat{\theta}\right\rvert > \pi \end{matrix}\right\}$	$\phi_2(v)$



FUTURE DIRECTIONS

We hope to deploy the social propensities approach in a series of experiments varying relationship type (principal-agent, coworker, parent-child, etc.) and task (game, business, etc.), with a selection (or a sampling) of possible outcome pairs from throughout the circumplex.

We also hope to expand our list of rules. Many other rules are possible. Here we mention some without formalizing them.

- Pareto constraint: Any rule modified with a constraint that outcomes that make either actor worse off are forbidden (p=0).
- Rawlsian Rule: If If O<S, MaxOther; otherwise MaxSelf
- Loss aversion: Any rule modified such that the self's losses are weighted more heavily than gains.
- Tit-for-Tat: Reciprocate the other's previous choice.
- Social aggregation weighting: Self and Other outcomes are weighted by the number of people in the ingroup and outgroup.
- Social categorization/distance weighting: Other's outcomes weighted by whether Other is in one's ingroup, possibly graded by social or geographic distance
- Temporal distance weighting: Self and Other's outcomes weighted (exponentially or hyperbolically) by their temporal distance from the present.

Finally, we see our approach as complementary to that of Fiske's (1991) theory of relational models. We see some of our social value rules as exemplifying some of his relational models, though we do not mean to suggest that there's a one-to-one correspondence.

Fiske Relational Model	Relevant Social Propensities
Communal Sharing (CS)	MaxJoint
Authority Ranking (AR)	Conditional on status and resource
Equality Matching (EM)	MinDiff
Market Pricing (MP)	Equity

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