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SOCIAL VALUES AND SOCIAL STRUCTURE

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The exchanges that individualist, prosocial, and competitive actors will make and the kind of negotiations they will carry out in dyads and power structures are predicted here for the first time. The predictions are generated by bridging two previously independent streams of thought, network exchange theory and social value orientations. In so doing, this article shows that formal, mathematical theory and metric predictions are not threatened by using multiple actors with contrasting utilities. Results offered here are hypothetical and provide a baseline against which empirical studies can be compared. A later paper will compare these predictions with experiments now ongoing.

Keywords: exchange ratio, interaction process, network exchange, social value orientation

1. SOCIAL VALUES AND SOCIAL STRUCTURE

Theories using rational actors typically share what Hardin (1982) called “the assumption of narrow rationality” (p. 11).¹ Under that assumption, actors seek to maximize outcomes to self, without regard for others. Hardin notes that it is sometimes claimed that narrow rationality “explains a very large fraction of behavior in certain realms” (p. 11). For Roth (1995), narrow rationality is “a useful approximation of behavior” that offers better predictive power than alternatives (p. 78). Furthermore, “[e]conomists and game-theorists argue that the hypothesis of selfish behavior is the only viable one as an organizing principle” (Ledyard, 1995, p. 121).

Nevertheless, research across many fields indicates that all is not well when a single rational actor model is used. An extensive review of Prisoner’s Dilemma experiments found that, though narrow rationality predicts universal defection, only about 50% of subjects defected while the other 50% cooperated (Sally, 1995). In social dilemmas where narrow rationality predicts that all will free ride (Olson, 1965), only about 50% do so (Simpson, 2004). The ultimatum game is an asymmetric

¹“Narrow rationality” and Roth’s “rational utility maximizers” (below) are the “individualists” of the social value orientation literature. See the definition of “individualist” in the following section.

Authorship is equal. The order of authors was determined by lot.

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exchange relation where one subject proposes a pool division that a second subject can only accept or reject. For a pool of 100 points, narrow rationality predicts a 99–1 division, but a massive cross-cultural study found that division to be one of the least likely selected (Henrich, Boyd, Bowles, Camerer, & Fehr, 2001). Returning to Roth (1995),

[i]n summary, there exists a substantial body of experimental evidence that shows that individuals are not ideally rational utility maximizers; on the contrary, there are a growing number of systematic violations of utility theory that can be robustly demonstrated and reliably replicated in the laboratory. (p. 78)

We apply network exchange theory (NET) to the problem. NET (Willer, 1984; Markovsky, Willer, & Patton, 1988; Skvoretz & Willer, 1993; Willer & Emanuelson, 2008) is a structural theory of power relations between actors in zero-sum exchanges. Surprisingly, NET has long used a single, narrowly rational actor with considerable predictive success (Willer & Emanuelson, 2008). However, that success does not support the assumption of narrow rationality because the experiments in which it has been tested *produced* narrow rationality in subjects. That is, experiments included “priming,” the demand that subjects be concerned only with their own payoffs. Furthermore, subjects were paid by points scored in negotiations. Previous research shows that narrow rationality can be induced but is moot concerning the acts that subjects would select if not so primed.

NET is not now and never has been committed to a single rationality. Nor should it be, as previous work has suggested that factors other than self-interest may guide individuals’ exchange behavior such as concerns for equity (Cook & Emerson, 1978) and status differences between actors (Thye, Willer, & Markovsky, 2006). NET’s explanatory power will be broadened by employing a broader conception of rationality and, correspondingly, by dropping the priming previously used in experiments. This thought echoes that change. Cohen (1989, Chapter 15) pointed out that one theory is more powerful than another if the former explains all of the phenomena explained by the latter and generates explanations that the latter cannot (see also Campbell, 1974).

Some have asserted that broadening the scope of theory necessarily results in loss of precision (e.g., Smelser, 1992, p. 403).² This article joins Macy and Flache (1995) in challenging that view. At issue here is whether metric predictions as precise as those previously produced can be generated for a broader scope of actors without contradictions or violations of parsimony in the theory.

To broaden the scope, we bridge from NET to another established area of research: social value orientation (Messick & McClintock, 1968). An actor’s social value orientation (SVO) is its preference regarding the distribution of resources between self and other. The analog to narrow rationality in the SVO literature is the *individualist*. Accordingly, our reformulation generates the same predictions as previous work in NET, provided that all actors are individualists. However, we examine two other SVO actor types: the prosocial (i.e., one who seeks equality

²Also see Ledyard (1995). Similarly, relaxing the scope of a theory, if done incorrectly “*weakens* the theoretical argument” (Walker & Cohen, 1985, p. 299).

and the maximization of joint outcomes) and the competitor (i.e., one who seeks to maximize the difference of self minus other). A meta-analysis conducted by Au and Kwong (2004) found that 86.6% of subjects in published experiments are classifiable as one of the three SVOs: individualists 23.5%, prosocials 49.7%, or competitors 13.4%. Furthermore, SVO research has shown that people are not smoothly distributed across the SVO spectrum, but instead almost all cluster at the three types (Kuhlman & Marshello, 1975, p. 930). By incorporating social value orientations, NET can generate a new set of predictions which are consistent with previous findings regarding social value orientations' effects in other interdependencies (Bogaert, Boone, & Declerk, 2008), such as social dilemmas (Balliet, Parks, & Joireman, 2009).

Importantly, incorporating SVO types into NET results in new kinds of predictions beyond those previously derived from NET or any other exchange theory. Previously, exchange theories focused only on predicting outcomes in the form of exchange ratios. Exchange ratios translate into the distribution of value agreed to by the exchanging actors. We will offer those predictions here and predict the processes through which agreements on exchanges are reached. Previously, with a single theoretic actor, being always the same, interaction processes commanded scant attention. Now, by embedding actors with contrasting SVOs in exchange relations and structures, there are very good reasons to assert that negotiation processes will systematically vary. Thus predictions are also offered for those processes.³

The article is organized as follows. SVOs are defined and formalized. Actors with those SVOs are placed in the positions of exchange relations and exchange structures with known properties. Then resistance (Willer, 1984, 1999) generates new predictions for exchange ratios. Placing actors with three SVOs in the five positions of two structures gives $6 + 18 = 24$ metric predictions for exchange ratios. Further predictions from resistance include (a) relative length of negotiation process, (b) likelihood of agreement, and (c) relative satisfaction of each SVO actor. The internal consistency of the new NET-SVO theory and the precision of its predictions are tested by critical examination. We conclude with thoughts toward empirical tests.

2. UTILITY, PAYOFFS, AND SOCIAL VALUE ORIENTATIONS

Studied across a number of disciplines, SVOs were developed to dispel the common perception of human beings as necessarily motivated solely by self-interest (e.g., Von Neumann & Morgenstern, 1944/2004) and provide insight into other-regarding behavior occurring in experimental games (Messick & McClintock, 1968). SVOs are preferences for how outcomes are distributed between self and other in interdependent situations (Liebrand, 1986; Liebrand & McClintock, 1988; Kollock, 1998). According to SVO researchers, "different individuals assign different

³Because the theory offered here covers broad scope, it is inevitably the case that some of its predictions will have been anticipated by previous work. For example, the synthesis of SVO and NET predicts that, in dyadic exchanges, the negotiations of prosocials will be shorter than those of other SVO types, which is consistent with previous experimental results by DeDreu and Van Lange (1995). The reader should not conclude from that consistency that nothing new was offered here. To the contrary, De Dreu and Van Lange's results are one place where the SVO-NET theory currently has empirical support. Certainly, it should be obvious that theoretically covering a result is not redundant of that result (see Popper, 1959, p. 313).

weights to their own and to others' outcomes. These weights define the actor's social value orientation" (Liebrand & McClintock, 1988, p. 397).

As will be shown, the formalization below closely follows the social value literature. In a comprehensive review, Bogaert et al. (2008, p. 456) offered the following meanings for the three SVOs:

- Individualists: "strive to maximize their own outcome only."
- Competitors: "strive to maximize their own gains relative to others' gains."
- Prosocials: "strive to maximize joint outcomes and equality in outcomes."

Where i and j are actors in an exchange relation, U_i is the utility of i , P_i is i 's payoff and P_j is j 's payoff, SVO actors seek to maximize the following utility functions⁴:

$$\text{Individualist: } U_i = P_i \quad (1)$$

$$\text{Competitor: } U_i = P_i - P_j \quad (2)$$

$$\text{Prosocial: } U_i = P_i + P_j - |P_i - P_j| \quad (3)$$

As already mentioned, the individualist actor is the rational agent previously used in NET. The utility equation for the competitive actor follows closely usage in SVO literature which often defines the competitor in terms of a difference function. Importantly, the difference function gives an unambiguous payoff set for the competitive actor. Since any actor will exchange only if $U_i > 0$, the competitor will reject any settlement for which $P_j \geq P_i$. In words, because any actor exchanges only if its utility is greater than zero, the competitive actor will exchange only if its payoff is greater than the payoff of the other with whom it is exchanging.

Though prosocial is sometimes defined by an additive function (Kuhlman, Camic, & Cuhna, 1986), Simpson (2004) is more complete: "Prosocials seek to maximize the sum of outcomes and to minimize inequality in outcomes to self and to other" (p. 388; also see Simpson & Macy, 2004, pp. 1378–1379; Van Lange, 1999).⁵ In Eq. (3), $P_i + P_j$ is the sum in Simpson's definition while subtracting the absolute value of $P_i - P_j$ gives the minimization of outcome inequalities. Importantly, unlike many previous applications of SVO formulations, exchange is a zero-sum game. Therefore, for any given exchange relation $P_i + P_j = \text{constant}$. In the examples of this article $P_i + P_j = 10$, but any other value for the constant could have been chosen.

This would be a good time to define the term "utility" and to examine its usage. While fundamental to economic theory, as a primitive term the meaning of utility itself is surprisingly elusive. Offering no definition of their own, Luce and Raiffa

⁴Previous utility models of SVO, such as Wyer's (1969), parameterized actors' level of interest in self and/or other. Admittedly, such a model would be useful in generating predictions in empirical tests. However, here we deal with ideal types, and thus feel that using utility models specified for each SVO type is appropriate here.

⁵Simpson and Macy's (2004) formulation applies when $n \geq 2$. When $n = 2$ as it does in all exchange relations their factor reduces to the one used here.

(1957) defer to von Neumann and Morgenstern (1944/2004) who do no more than suggest that utility and “satisfaction” have the same meaning (p. 8). While the meaning of utility itself remains somewhat nebulous, one aspect of its usage should be noted. Unlike length, there is no “outside thing” against which any two people’s utilities can be standardized (Luce & Raiffa, 1957, p. 34). As a result, utility units are particular to each individual and cannot be compared interpersonally. Since each SVO actor type is a theoretic person, utility comparisons that are *within* type are legitimate. Utility comparisons *between* types are not. For example, if the utility of a prosocial actor is 100 in one relation and 50 in another, the assertion that utility is higher in the first is legitimate. If the utility of the prosocial actor is 100 and the utility of the individualist actor is 10, even if those two occur in the same relation, no comparison is legitimate.⁶ By contrast, below “relative satisfaction” is introduced and it can be compared between actors.

3. SOCIAL VALUES IN RESISTANCE EQUATIONS

SVO researchers have studied a remarkable range of phenomena (Simpson, 2004, p. 387), but they have yet to predict the behavior of actors with contrasting SVOs in exchange dyads and power structures—as will now be done here. To do so, resistance equations are generalized so that the values of connected SVO actors can drive their negotiations and agreements to exchange.

NET uses resistance equations to capture “each actor’s mixed motives in exchange to predict exchange ratios” (Willer & Emanuelson, 2008, p. 175).⁷ The basic idea is that when considering a possible exchange, the actor balances the interest in gaining the payoff of a better agreement against the interest in avoiding confrontation, the payoff when failing to exchange. The actor i ’s resistance is:

$$R_i = \frac{P_{i_{\max}} - P_i}{P_i - P_{i_{\text{con}}}} \quad (4)$$

where P_i is i ’s payoff, $P_{i_{\max}}$ is i ’s maximum payoff (i ’s best hope), and $P_{i_{\text{con}}}$ is i ’s payoff at confrontation when agreement is not reached.

Here is how the resistance factor works. The numerator, the difference between $P_{\max}$ and P , the payoff being considered, is the interest in a better agreement. The denominator, the difference between the payoff being considered, P and P_{con} , the payoff when failing to exchange, is the interest in avoiding disagreement—confrontation when no exchange occurs. For any exchange with a very good payoff, the numerator is small, the denominator is large, and the value of R is small. The actor has little resistance. When the payoff is very bad, however, the numerator is very large, the denominator is very small, and the value of R is very large. The actor is highly resistant. Seen dynamically, resistance is the extent to which the pursuit of better outcomes is inhibited by the avoidance of confrontation.

⁶For further discussions of utility and the illegitimate use of interpersonal utility comparisons, see Willer (1999).

⁷Resistance is algebraically equivalent to the Raiffa (1953) and Kalai and Smorodinsky (1975) solutions.

A----10----B

FIGURE 1 A resource pool relation.

B----10----A----10----C

FIGURE 2 Br21 strong power structure.

We now generalize resistance by substituting utilities for payoffs. Since NET previously used only the individualist actor, substituting Eq. (1) ($U_i = P_i$) into Eq. (4) gives the more general equation:

$$R_i = \frac{U_{i\max} - U_i}{U_i - U_{i\text{con}}} \quad (5)$$

NET's second principle asserts that exchange occurs when the resistance values of the two actors are equal. Setting $R_i = R_j$

$$\frac{U_{i\max} - U_i}{U_i - U_{i\text{con}}} = \frac{U_{j\max} - U_j}{U_j - U_{j\text{con}}} \quad (6)$$

Note that resistance is a “dimensionless” number. Though utility terms of two actors appear on the two sides of the equation, they appear in fractions and the dimension of utility cancels. Thus, Eq. (6) does not make interpersonal utility comparisons.

Throughout the remainder of the article, we will simulate exchange with the resource pool relations of Figures 1 and 2.⁸ In the Figure 1 dyad, the actors A and B may divide a pool of 10 resources. The resources are lumpy in units of 1. Since any actor will exchange only if $U > 0$, the largest number of points either actor can receive is 9. For the individualist actor $U_i = P_i$. Therefore, $U_{\max} = 9$. By contrast, $U_{\max}$ for the prosocial actor does not occur at the end of the negotiation set but rather where payoffs for the two actors are equal at 5. Remember that $U_i = P_i + P_j - |P_i - P_j|$. In words, i 's utility is the sum of the two payoffs minus the *absolute value* of the difference of the two payoffs. Since $P_i + P_j = 10$, it follows that utility is maximal when $P_i - P_j = 0$. Therefore, for prosocial actors, $U_{\max} = 10 - 0 = 10$. Turning to the competitive actor, where $U_i = P_i - P_j$ it follows that $U_{\max} = 9 - 1 = 8$. Finally, since no resources move when agreement is not reached, $U_{\text{con}} = 0$ for all three types of actors.

Where R_I , R_P , and R_C denote individualist, prosocial, and competitive actors, respectively, for either actor in the Figure 1 dyad,

$$R_I = \frac{9 - P_i}{P_i - 0} \quad (7)$$

⁸As van Assen (2001) pointed out, resource pools have the same payoff matrix as many, but not necessarily all exchange relations.

$$R_P = \frac{10 - (P_i + P_j - |P_i - P_j|)}{P_i + P_j - |P_i - P_j| - 0} \tag{8}$$

$$R_C = \frac{8 - (P_i - P_j)}{P_i - P_j - 0} \tag{9}$$

4. PREDICTIONS FOR SVO ACTORS IN THE DYAD

Resistance predicts that agreement occurs at the point where the resistance of the two actors is equal. This section sets the factors to the right of Eqs. (7–9) equal to each other which, in all but one case, give a unique solution. The exception is paired prosocials. To find a unique solution for that pairing we add a second condition: Exchange occurs at the lowest resistance value. Below we justify that condition.

Resistance equations are used to generate four different kinds of predictions. First and most importantly, resistance equations give metric predictions for exchange ratios. Second, that prediction allows the calculation of “relative satisfaction” of the actor. Relative satisfaction is the ratio of the actor’s utility at agreement to utility at the actor’s *P*max. As a ratio of utilities, relative satisfaction is dimensionless and thus can be compared across actors.

Previously exchange theories focused on equilibrium exchange outcomes only. By embedding contrasting SVOs in exchange relations, however, the third and fourth kinds of predictions concern how negotiation processes will systematically vary. While the exchange ratio at agreement is predicted at equal resistance, at that point the numerical value of *R*, the resistance factor, varies across SVO types and across structure types as well. Higher *R* values imply longer negotiations and a higher likelihood that negotiations will fail. Therefore, resistance also gives ordinal predictions for length of negotiation processes and the likelihood of their completion.

Table 1 shows predicted payoffs, and utility values for the A–B dyad. We now show how those values are arrived at by first analyzing exchanges between similar SVO actors and then moving to exchanges between different SVO actors.

When A and B are individualist actors,

$$\frac{9 - P_A}{P_A - 0} = \frac{9 - P_B}{P_B - 0}$$

TABLE 1 SVO Dyads Ordered from Lowest to Highest Resistance

Position						
A	B	<i>P_A</i>	<i>U_A</i>	<i>P_B</i>	<i>U_B</i>	<i>R</i>
Prosocial	Prosocial	5.00	10.0	5.00	10.0	0
Individualist	Prosocial	6.43	6.43	3.57	7.14	.400
Prosocial	Competitor	2.78	5.56	7.22	4.44	.800
Individualist	Individualist	5.00	5.00	5.00	5.00	.800
Individualist	Competitor	3.46	3.46	6.54	3.08	1.60
Competitor	Competitor	Ø	Ø	Ø	Ø	∞

Note. SVO = social value orientation.

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By identity, $P_A = 5$ and $P_B = 5$. In fact, this is the exchange typically predicted in previous applications of resistance.

For paired prosocial actors

$$\frac{10 - (P_A + P_B - |P_A - P_B|)}{P_A + P_B - |P_A - P_B| - 0} = \frac{10 - (P_B + P_A - |P_B - P_A|)}{P_B + P_A - |P_B - P_A| - 0}$$

The solution $P_A = 5$ and $P_B = 5$ occurs when $R_A = R_B = 0$ and all other solutions occur at higher R values. For example, the 6-4 exchange also occurs at equal resistance but then $R_A = R_B = .25$. More unequal exchanges occur at yet higher R values. As asserted above, higher R values imply longer negotiations. It follows that two prosocials will arrive at the $P_A = 5$ and $P_B = 5$ agreement *prior to* all others thus ending negotiations.

Whereas the predicted payoffs for prosocials and for individualists are the same, there is an important difference. For prosocials at settlement, $R_A = R_B = 0$, but for individualists $R_A = R_B = .8 > 0$. Below, we trace the implications of these differences for interaction processes.

Competitive actors cannot exchange with each other. Remember that exchange can occur if $U > 0$ for both actors. But $U_A = P_A - P_B$ and $U_B = P_B - P_A$. It follows that when $U_A > 0$, $U_B < 0$, and conversely. Two competitors cannot both have utilities greater than zero. Thus, they cannot exchange with each other. As explained below, however, competitors can exchange with all other SVOs. While we predict nonexchange for two competitors, we acknowledge that, in an “imperfect world” exchange may in fact occur. Nevertheless, the extent to which our theoretical predictions in this area are not accurate can only be accessed through empirical testing.

Turning now to mixed SVO dyads, for individualist A and prosocial B,

$$\frac{9 - P_A}{P_A - 0} = \frac{10 - (P_B + P_A - |P_B - P_A|)}{P_B + P_A - |P_B - P_A| - 0}$$

Because $P_A + P_B = 10$, substituting, $P_A = 6.43$ and $P_B = 3.57$. We count this outcome as a power exercise for the following reasons. In NET and other exchange theories, power is exercised when one actor benefits at the expense of the other (Cook, Emerson, Gillmore, & Yamagishi, 1983; Willer, 1999). “Benefit” and “expense” are measured from an equal power baseline. Previously, the equal power baseline was found by removing all structural power conditions. Here we find the baseline by also removing all power conditions due to actors’ SVOs by pairing identical actors.

From both above pairings we see that that equal power baseline is $P_A = 5$ and $P_B = 5$. But the individualist A’s payoff is 1.43 more and the prosocial B’s payoff is 1.43 less than either would have gained at equal power. Thus, A has exercised power over B and that power exercise is wholly a result of actor SVOs. To our knowledge this result is unique: power inequality is predicted in an equal power structure. The two pairings to follow share that distinction.

For individualist A and competitor B

$$\frac{9 - P_A}{P_A - 0} = \frac{8 - (P_B - P_A)}{P_B - P_A - 0}$$

Substituting $P_A + P_B = 10$ and solving, $P_A = 3.46$ for the individualist and $P_B = 6.54$ for the competitor. Once again this is a power exercise because B benefits at A's expense. Thus the competitor exercises power over the individualist.

Finally for prosocial A and competitor B,

$$\frac{10 - (P_A + P_B - |P_A - P_B|)}{P_A + P_B - |P_A - P_B| - 0} = \frac{8 - (P_B - P_A)}{P_B - P_A - 0}$$

substitute and solve $P_A = 2.78$ for the prosocial and $P_B = 7.22$ for the competitor. This is also a power exercise for the same reason given above: B is benefiting at A's expense. Thus the competitor exercises power over the prosocial.⁹

5. FURTHER DYAD PREDICTIONS

Analysis of the six dyadic pairings is extended here to include (a) predictions for interaction processes, (b) inferences for the likelihood that each pairing will exchange, and (c) predictions for the relative satisfaction of actors. The likelihood of exchange is inferred from the value of resistance at settlement: the higher that value the more frequently paired actors should *fail* to reach a settlement. As labeled, Table 1 is ordered from lowest resistance in the top pair to highest resistance in the bottom pair.

While paired individualists and paired prosocials are predicted to exchange at equal power 5–5 divisions, they sharply differ in how they reach that value. Because exchange is a mixed-motive game for individualists, they will bargain to compromise at 5–5. A's best hope is to gain 9 leaving only 1 to B. But a payoff of only 1 is too little to motivate B to exchange—and similarly for A for offers of 1–9 from B. While each prefers exchanges with higher payoffs to self, both are moved to compromise by the need to gain agreement of the other. Thus bargaining occurs here and in all other dyads but paired prosocials. Importantly, the working of the interests that produce bargaining is seen in the two resistance factors that compose the resistance equation. For each factor, the size of the numerator is the strength of the interest in a better settlement while size of the denominator is the strength of the interest in exchanging.

By contrast, paired prosocials transform exchange such that it loses its mixed-motive quality. Because the 5–5 division is Pmax (the most preferred outcome), the negotiation process is predicted to have one offer, 5–5 by either actor and immediate acceptance by the other. Said somewhat differently, for paired prosocials, the 5–5 agreement is not a compromise: because it is not, there is no bargaining process. Since agreement occurs at $R=0$, two prosocials should never fail to exchange. By contrast, at the same settlement, $R=.8$ for paired individualists. Because that is the second highest R value of the six pairings, paired individualists should have the second highest failure rate. But note that prosocial–prosocial is the only pairing in which exchange is not mixed motive.

⁹SVO research by De Dreu and Van Lange (1995) on exchange found that prosocials made lower first offers and greater concessions than other types. Their results are supportive to at least some degree of what is predicted above and below.

The predicted individualist–prosocial settlement is 6.43–3.57, and the predicted competitor–prosocial settlement is 7.22–2.78. Both predictions fit well the SVO literature’s contention that prosocials are subject to exploitation by other SVOs (Orbell & Dawes, 1993). As seen in Table 1, resistance values in these two pairings are, respectively, quite low and medial. Those values imply that, were a prosocial to enter into either exchange relation, it is likely to be completed. To avoid exploitation, those relations must be avoided.

But there is a second interpretation of these two pairings. For that interpretation we employ “relative satisfaction” which is the ratio of the utility at agreement to maximum utility. When exchanging with the individualist, the prosocial’s relative satisfaction is 71.4% (7.14/10). And the individualist’s relative satisfaction is the same. When exchanging with the competitor, the relative satisfaction of the prosocial is lower: $5.56/10 = 55.6\%$. Again, the exchange partner, here the competitor, has the same relative satisfaction value. In fact, equal relative satisfaction is a mathematically necessary at equal resistance.

How does the relative satisfaction of the prosocial when exploited compare to the relative satisfaction of other SVOs in other relations?¹⁰ In individualist–individualist exchange, relative satisfaction of each is $5.0/9.0 = 55\%$ while the relative satisfaction of the competitor when exchanging with the individualist is $3.08/8 = 38.5\%$. Both are substantially *lower* than the relative satisfaction of the prosocial when exploited by either individualist or competitor.¹¹ Average relative satisfaction across all relations is: prosocial = 75%, individualist = 55% and competitor = 47%.

While exploitable, we predict that prosocials will be the most successful type in negotiating and completing exchanges. Both predictions follow from the fact that, in all pairings, agreements with prosocials occur at the lowest R values. At the extreme, $R = 0$ for paired prosocials: They do not negotiate and always exchange. That the prosocial is the most successful of all types in negotiating and completing exchanges suggests that the prosocial will be advantaged in a wide array of situations.

More so than any other exchange, the competitor–individualist exchange is a major clash of interests. The predicted settlement, 6.54–3.46, respectively, occurs at 1.6, the highest resistance value of all pairings. That value is fully twice the R value of the second highest. Putting aside paired competitors who cannot exchange, this pairing is predicted to have the longest negotiations and to fail to reach agreement more frequently than any other. Looking back over all pairings, the competitor is everyone’s least preferred partner, even for another competitor. That prediction fits well the fact that, of the three SVOs, competitors form the smallest proportion in contemporary societies.

6. PREDICTIONS FOR SVO ACTORS IN Br21 POWER STRUCTURES

A strong power structure is a network with two types of positions: high power positions which are never excluded and low power positions, at least one of which must be excluded. Low power positions are connected only to high power positions.

¹⁰Note that comparing relative satisfaction is not comparing utilities: Relative satisfaction is dimensionless.

¹¹Furthermore, the relative satisfaction of paired prosocials is 100%.

With one high power position connected to two low power positions, Br21, displayed in Figure 2, is the simplest strong power structure. The high power position exchanges once, excluding one of two low power positions. Since NET previously used only individualist actors, all positions of Br21 were occupied by individualists. We begin by showing how the power process of individualists is modeled and then generalize to structures peopled by all combinations of SVO types.

To predict exchange ratios in strong power structures, resistance is applied iteratively. The application begins by calculating the exchange between the central and one peripheral exactly as in the previous section. For example, when the actors are individualists, the A–B exchange, as seen above, is the 5–5 division. Let that division be the standing A–B offer that, in turn, alters the conditions of exchange with C, the second peripheral. Now failure to complete the A–C exchange will result in a payoff of 5 to the central A. Thus, $P_{A\text{con}} = 5$. To be considered, C's offer must be better than that made by the first peripheral. Thus, $P_{C\text{max}} = 9 - 5 = 4$ and

$$\frac{9 - P_A}{P_A - 5} = \frac{4 - P_C}{P_C - 0}$$

$P_A = 7.5$ and $P_C = 2.5$. In turn, this result alters the conditions of the new A–B negotiations and similarly through further iterations to the 9–1 extreme favoring A. Observed interaction processes are also iterative. One interaction process finds A eliciting a sequence of better and better offers from B and C while, in a second, B and C bid making better and better offers to A. Either process produces the 9–1 extreme payoffs favoring A.

As will now be seen, populating the structure with other SVOs can substantially alter this process. The predictions to follow assume that all actors see the events of both exchange relations. That is to say, all negotiations and agreements are public.

As shown in Table 2, given three SVOs, there are $(2/3) \times 3^3 = 18$ unique Br21 structures. In calculating the exchange ratios for each structure, we discovered three kinds of structures: exploitative, egalitarian, and split. *Exploitative structures* have iterative interaction processes as in the example above, are solved iteratively, and exchange ratios move to the 9–1 extreme favoring the central position. *Egalitarian structures* have a variety of processes all ending at equal exchange ratios of 5–5. In *split structures* the structure divides such that negotiations proceed dyadically on only one side of the branch structure.

6.1. Exploitative Structure

As seen in Table 2, six structures are exploitative, and, as above, all have step-by-step processes. In fact, iteration is a power process and high power positions prefer shorter to longer processes. To shorten the process, the central begins negotiations with the peripheral which will yield the largest first step. The size of the first step can be read from Table 1. As we have seen, when all actors are individualists the first step is the 5–5 division which is $5/9 = 56\%$ of the distance to the 9–1 endpoint of the power process. When individualist is central with at least one prosocial, the first step is 6.43–3.57, which is 71% of the distance to the endpoint. When the competitor is central and has two individualist peripherals, the first step is

TABLE 2 Eighteen SVO Power Structures

Configuration	Exchange ratio	Type
PS–C–PS	9:1	Exploitative
PS–C–I	9:1	Exploitative
PS–I–PS	9:1	Exploitative
PS–I–I	9:1	Exploitative
I–C–I	9:1	Exploitative
I–I–I	9:1	Exploitative
PS–PS–PS	5:5	Egalitarian
PS–PS–I	5:5	Egalitarian
PS–PS–C	5:5	Egalitarian
I–PS–I	5:5	Egalitarian
I–PS–C	5:5	Egalitarian
C–PS–C	5:5	Egalitarian
C–I–C	5:5	Egalitarian
PS–I–C	7.22–2.78	Split
I–I–C	6.54–3.46	Split
PS–C–C	7.22–2.78	Split
I–C–C	6.54–3.46	Split
C–C–C	Ø	Ø

Note. SVO = social value orientation; PS = prosocial; C = competitor; I = individualist.

6.54–3.46 or 73% of the distance to the maximum. When the competitor has at least one prosocial peripheral, the first step is 7.22–2.78, which is fully 80% of the distance to the end of the process. If total iteration process is proportional to the first step, the structure populated only by individualists has the longest power processes of all exploitative structures. The exploitative structures are ranked from fastest (PS–C–PS) to slowest (I–I–I).

6.2. Egalitarian Structure

Seven Br21 structures are egalitarian: their equilibrium exchange ratios are 5–5, but that division is not attained by the same processes. In the PS–PS–PS structure, the 5–5 division is Pmax for all. As in the PS–PS dyad, there is no negotiation. The C–I–C structure iterates like exploitative structures, but ends at divisions just slightly more favorable to the Cs than 5–5. Just better than equal division is the least favorable exchange ratio either C will accept.

All remaining egalitarian structures have prosocial central positions and all iterate to end, not at the extreme, but at 5–5 which is optimal for the prosocial. As modeled, the first step of negotiations between the central prosocial and any other type at the periphery will result in an unequal division favoring the peripheral, low power actor. From that point, the iteration process *runs backward* to end at 5–5 which is Pmax for the prosocial. That is, *the central prosocial uses its power position to impose equality*.

6.3. Split Structure

All split structures have one low power competitor. When the central position is also a competitor, the two cannot exchange. Thus, on the other side of the branch,

the exchange occurs at the dyad exchange ratio given in Table 1. When the central position is individualist, there is a brief iteration ending just prior to the 5–5 exchange between central individualist and peripheral competitor. Subsequent negotiations are dyadic being confined to the central individualist and the other peripheral.

6.4. Shortcuts for Inferring Exchange Outcomes

There are three rules that infer predictions for all Br21 networks:

1. If prosocial is not central, a single peripheral competitor produces a split.
2. If the central actor is a prosocial, or if the peripheral actors are both competitors, the structure will be egalitarian.
3. All other structures are exploitative.

7. ANALYSIS OF PREDICTIONS FOR POWER STRUCTURES

The analysis of Br21 structures is now extended to the likelihood of exchange and the relative satisfaction of the actors. As will be remembered, the likelihood of exchange is predicted from resistance at settlement: the lower the resistance, the higher the likelihood of exchange. Within egalitarian and split types of Table 2, resistance at settlement is ordered from lowest to highest. Exploitative is ordered by speed of reaching the equilibrium settlement point.

Failure to exchange is very unlikely in exploitative networks because the iteration process *reduces* resistance of both high and low power actors even as pay-offs become more and more unequal. Though resistance at equilibrium is a small number for all instances, some reach that point more rapidly than others and thus are ordered by that speed. Exchanges will fail only very rarely in strong power structures, which is empirically supported by previous research. Since previous research was only on structures populated by individualists, and since individualists are predicted to have the longest power process, there is reason to suppose that failure to exchange for the other exploitative types will be very unlikely.

Failure to exchange is more likely for some egalitarian than exploitative types because there is no iteration process to drive down resistance. However, the failure rate should be either zero when two prosocials can exchange or no worse than that of corresponding dyadic exchanges. That leaves the split structures where failure rates again are no higher than corresponding dyads.

Given the qualities of strong power structures, precise inference of relative satisfaction is straightforward for half the structures—the ones in which there is no competitor at the periphery. For that half, the central position is always at its maximal level of relative satisfaction because it is receiving its P_{max} payoff. Furthermore, when an individualist or a competitor is central, peripherals exchange at their lowest relative level of relative satisfaction. By contrast, when prosocial is central, exchanges are egalitarian and relative satisfaction is maximal for prosocial peripherals and medial for the other types.

We now turn to a broader question that concerns the prosocial acting in a strong power structure. In calculating exchange ratios for that structure, actors

are modeled as focusing on exchange partners and *not* on others acting in the structure. Drawing from the SVO literature, prosocials are seen as concerned with equity, not just dyadically, but for all others in the group as, for example, in $n > 2$ social dilemmas (Liebrand, Willke, Vogel, & Wolters, 1986; McClintock & Liebrand, 1988; Van Lange & Kuhlman, 1994). As modeled here, the prosocial always prefers equity and, when in the central, high power position, can produce that state throughout the structure. Thus, when acting from the high power position, the prosocials' actions fit well the broader SVO understanding of how prosocials act.

What happens with the prosocial when acting from the periphery? As modeled here, the peripheral prosocial focuses exclusively on its exchange partner, the high power position. This seems inconsistent with broader SVO understandings. What about the welfare of the other low power actor? Given the model we have used, the question is moot. When low in power, the prosocial cannot help the other low power actor because it cannot help itself. Unless the central is also prosocial, or the other peripheral is not competitive, exploitation will go to the maximum regardless of where the peripheral prosocial is looking or what its concerns. But there is an important qualification.

If the analysis is extended to allow coalitions to form among low power peripherals, prosocials will be able to act on their concern for the other peripheral. We know from the SVO literature that, given the opportunity to act collectively, prosocials will cooperate and act collectively (Liebrand, 1984; DeCremer & Van Lange, 2001). Furthermore, previous NET formulations and research has shown that power will be countervailed if peripherals cooperate to act collectively (Simpson & Willer, 2005; Borch & Willer, 2006). Thus, if coalitions are possible, low power prosocials should form them and, once formed, should act to express their concerns for others by countervailing power.

8. EVALUATION AND CONCLUSION

Previously, NET, like many other formal, mathematical theories, was grounded in a single kind of rational actor, an actor who seeks to maximize outcomes to self without regard for others. Using only that one actor exemplifies the assumption of narrow rationality. As traced in the introduction, it is broadly recognized that narrow rationality does not explain a large fraction of human behavior. Since it does not, why not adopt a broader rationality? Two reasons have been put forward. First, a broader rationality would destroy the internal logic of the theory. Second, employing broader rationality would subvert the precision of its predictions. We proposed to test those claims by building a new, broader theory and have done so. We now evaluate its logical structure and predictive capability.

In the new, broader theoretic models, actors with three contrasting SVOs are placed in the exchange relations and power structures of NET to interact, making offers and concluding agreements. These models are built in just two steps. The first step defines the three actors by setting utility equal to the specific payoff function of the actor. For individualist, $U_i = P_i$; for competitor, $U_i = P_i - P_j$; and for prosocial, $U_i = P_i + P_j - |P_i - P_j|$. In each case, the utility function closely follows definitions offered in the SVO literature. The second step generalizes NET's resistance function. Applying the individualist's utility function ($U_i = P_i$), the payoff terms previously in

the resistance function are replaced by utility terms. Now the generalized resistance equation can accept the payoff functions of any of the three rational actors. For example, this equation was used to predict the exchange ratio for competitor and prosocial:

$$\frac{10 - (P_A + P_B - |P_A - P_B|)}{P_A + P_B - |P_A - P_B| - 0} = \frac{8 - (P_B - P_A)}{P_B - P_A - 0}$$

The rest of the theory work consists of (a) plugging all pairings of actor's utility functions into the resistance equation, (b) grinding out predictions for the dyad and simple power structure, and (b) interpreting the predictions.

The new, broader theory is organized in exactly the same way as was the narrower theory previously employed. The two theories differ only in this: In the new broader theory three actor functions instead of one are plugged into the resistance equation and a much broader array of behaviors is ground out. Since there was no change in theory organization or its procedures, using three actor functions did not introduce contradictions. Nor did it subvert the precision of the theory or its predictions. Rather, by incorporating social value orientation into NET, we are able to generate a new set of predictions which had previously not been possible. Because this new formulation both covers all previous findings when all actors were individualists *and* generates new predictions, the new formulation meets Popper's (1959), Lakatos's (1970), and Cohen's (1989) criteria of being more powerful than previous versions of NET.

In the introduction it was asserted that the broader rationality of the three SVO types does not compromise parsimony because the small increase in complexity relative to the narrow rationality is trivial in light of the substantial increase in potential predictive power. But was the increase in complexity small? Looking back through the article we find page after page of plugging in and grinding out for all combinations of SVOs. But the number of calculations that a theory can make is not a measure of its complexity. Instead, parsimony is measured by numbers of basic concepts (Lakatos, 1970; Popper, 1959, 1994). The new broader theory changed no procedures in the theory. It merely added two SVOs, prosocial and competitor. That is, it added only two basic concepts.

On the other hand, the number of calculations that a theory can make may well be a good indicator of its scope. With broader scope there is more to test and that testing is slightly more complex than previously. Now instead of experimentally testing the theory in structures with just one SVO type, three types are needed. To that end two contrasting procedures can be suggested. The first uses the SVOs that subjects bring to the laboratory. The experiment would begin by measuring subject SVOs and, with subjects' SVOs identified, they would be placed as needed into relations and structures of the experiment. Alternatively, since the individualist value orientation has been successfully produced in the lab, it seems plausible that priming and framing could produce prosocial and competitive SVOs as well. Research now ongoing uses the first of these procedures.

Since moving to a broader rationality did not introduce contradictions or make predictions less precise, perhaps other theories can be generalized as well. For example, Simpson (2004) has shown that social values systematically transform

the payoffs of games that are social dilemmas, a demonstration that suggests that game theory could also adopt a broader rationality. On the other hand, it is difficult to imagine neoclassical microeconomic theory without its grounding in narrow rationality.

This article has been an exercise in mathematical social theory, an exercise that has produced an image of an abstract world not previously imagined. In that world and in no other previously generated, the power exercise previously seen in power structures is nullified by the presence of prosocial actors. And the events of dyads, previously power balanced, have been thrown into imbalance when different kinds of actors are negotiating.

Is there a reality that corresponds to that image or is some or all of it pure fantasy? This much at least can be said. As already noted some of the predicted events for dyadic exchange relations actually correspond to previous experimental results. In power structures, however, we have everything to learn when people with contrasting social value orientations actually confront each other.

In the power structures modeled here, theoretic actors acted on fixed social value orientations, but we know that people are strategic. SVO literature shows that, in social dilemmas, prosocials resist exploitation which is to say they contingently move from one social value orientation to another (Kuhlman & Marshello, 1975; Van Lange & Visser, 1999). Nor should we be surprised because we know that the kindly father acting at home as a prosocial may well, as a capitalist, act as a ruthless competitor in the work place. If, as we suspect, future laboratory research shows that people move from one social value orientation to another in exchange structures, we will have discovered a new problem for theory.

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