Group Decisions: Analyzing Decision Strategy and Structure in Households

Wiktor Adamowicz (U Alberta) Vic.Adamowicz@ualberta.ca
Michael Hanemann (UC Berkeley) hanemann@are.berkeley.edu
Joffre Swait (U Alberta & Advanis) Joffre_Swait@Advanis.ca
Reed Johnson (Research Triangle Institute, NC) frjohnson@rti.org
David Layton (U Washington) dflayton@u.washington.edu
Michel Regenwetter (U Illinois Urbana-Champaign) regenwet@uiuc.edu
Torsten Reimer (Max Planck Institute for Human Development and U Basel) t.reimer@unibas.ch
Robert Sorkin (U Florida) sorkin@ufl.edu

1.0 Introduction

Traditional economic analysis has treated groups of individuals as single entities, an approach which runs the risk of erroneously assessing the impact of changes in prices, taxes, or demographic factors on group purchases or demands. Since significant economic activity arises from or is influenced by group decisions, errors in assessing the demand by groups will result in inaccurate prediction and policy making. While it is possible that the elements of group relationships cancel out in the aggregate, resulting in single-entity models that forecast choice behavior quite well, it is more likely that choice behavior, especially in response to *changes* in attributes, prices, or tax rates, will be better modeled by approaches recognizing the role of group bargaining, member power, decision strategy selection and so forth.

Our workshop consisted of economists, social and mathematical psychologists, and marketers, different disciplines that have generated a variety of non-overlapping insights into group decision-making. We focused on integrating this wide scope of knowledge to support future research in understanding, modeling and predicting demand for products and services that arises from group decisions. We limited ourselves to the examination of household decision-making in an effort to concentrate our efforts. This does not reflect on the relative importance of studying group decision-making in business or other non-household contexts, but is simply a self-imposed scope limitation that we found helpful.

Kirchler (1999) defines private households as two or more closely related persons living under a common roof. Typically, this specific group has a common history and future and will be faced with recurrent decision-making tasks. In the context of households, economic decisions can be classified according to the uniqueness or frequency of repetition of a decision, the costs involved, and whether or not the decision has an effect on all members of the household. We focus here on single decisions and exemplify how research on group decision-making can be exploited to gain a better understanding of household decisions.

We begin the paper by critically reviewing the unitary model (Vermeulen, 2002), which (1) assumes that a single preference represents all agents in the group, or equivalently, that all agents have identical preferences; (2) imposes the choice of a benevolent dictator on the group; (3) assumes the group's budget to be a single pooled value; (4) does not allow bargaining or negotiation, (5) nor permits knowledge or experience differences between members to lead to the use of different decision-making strategies. The impact of policies affecting group members differentially, for example, cannot be correctly assessed in the unitary model because its use will lead to erroneous welfare inferences (Vermeulen, 2002). Clearly, the need for alternative models is pressing.

In the remainder of this paper we will synthesize the literature across disciplines with a view towards characterizing the shortcomings of current approaches to modeling group decisions. Subsequently we broach a number of issue areas that we believe future research must address to improve our understanding of group decisions and to enhance our ability to model and predict outcomes from such decisions. We then present a conceptual model of group decision-making that arose from our discussions and, we feel, synthesizes the multidisciplinary views represented in the workshop. We conclude by proposing a number of specific research questions that we believe should be addressed in the short term.

2.0 Literature Review

2.1. Research on Group Decision-making in Economics and Marketing

Analyses of group decision making in economics generally share the neoclassical microeconomic perspective that such decisions can be analyzed within a framework that assumes individual members of the group or household maximize well-defined and relatively simple utility functions. Using this approach, a very large literature in economics and political science has been built on the foundations of Olson (1965), who identified conditions under which groups would under-supply jointly consumer goods and services. The primary reason posited for his negative conclusions regarding group provision is the problem of free riding: in the absence of coercion (through taxation or other means), any member of the group can benefit from the production of a non-excludable good without contributing to its cost of production.

Other authors have generalized Olson's results by allowing for general altruistic motives (Andreoni, 1990) in sharing behavior and more specific altruistic motives in household decision making. Gary Becker's *Treatise on the Family* (1981, 1991) has similarly led to a large theoretical and empirical literature on the economics of the household (see Pollak 2003 or Vermuelen 2002 for reviews). This literature has focused on the structure of demand for goods given assumptions on the nature of the bargaining game and pooling of the budget constraint.

The economic approach has been widely criticized. For example, in the inaugural issue of the journal *Feminist Economics*, Barbara Bergmann (1995) criticizes Becker's basic methodology: "In his analysis of the family, … Becker brings to bear the theoretical apparatus developed in the last hundred years for the analysis of markets. … It comes to plainly ridiculous conclusions because it is too simple: it leaves out considerations of prime importance. …

Becker's method of thinking about the family leads … to a conclusion that the institutions depicted are benign, and that government intervention would be useless at best and probably harmful." (Bergmann 1995, p. 149)

More recent advances in economics have attempted to expand on the behavioral underpinnings of household choices but have done so within a utility maximizing agent-bargaining game structure. Similar efforts have appeared in the marketing (e.g., Arora and Allenby 1999) and transportation literatures (Zhang et al. 2004).

2.2. Research in Social Choice and Group Decision-making

Social choice theory has examined group decision-making in the context of political or social decisions. Historically, the most prominent methods of preference aggregation by societies are Condorcet's majority rule, Borda's scoring rule and the plurality scoring rule. The latter is the most common and intuitive voting method used today. For a review, see McLean and Urken (1995) or Saari (2001). For a behavioral approach see Regenwetter et al. (forthcoming).

The three arguably most important historical stepping stones of social choice research are Condorcet's 18th century paradox of majority cycles, and two Nobel prize winning results in the 20th century, namely Arrow's (1951) impossibility theorem and Sen's (1966) possibility theorem. Condorcet's majority rule is susceptible to *cycles*, where a majority prefers *j* to *k*, a potentially different majority prefers *k* to *l* and a potentially yet different majority prefers *l* to *j*. Arrow's (1951) *impossibility theorem* is commonly interpreted as demonstrating that rational preference aggregation is impossible, because Arrow proved that a simple set of rationality axioms for social choice are mutually incompatible. Sen's (1966) *value restriction*, which is a generalization of Black's (1958) *single-peakedness* condition, restricts the domain of permissible preferences in such a way as to rule out the Condorcet paradox, and thus makes Condorcet's majority rule a potentially viable aggregation method. These conditions may be plausible constraints on the distribution of preferences in households, but have not yet been empirically tested on household data. We know of no work on households regarding the potential empirical redundancy among social choice rules.

2.3. Research on Group Decision-Making in Social Psychology

In contrast to studies in economics and social choice theory, research in social psychology has focused on non-strategic decision tasks in which group members share objectives (for reviews see Hinsz et al. 1997; Kerr & Tindale 2004). There is ample empirical evidence across a wide range of tasks (e.g., across preference as well as inference tasks) and across different standards of comparison (e.g., with regard to a nominal group or to an outside criterion) that groups often systematically differ from individuals in how they make decisions. Such differences can pertain to all parts of the decision process – to the attention and information search phase, to the information-processing phase, and to the decision phase.

Crucial to understanding information processing in groups is the homogeneity of its members with regard to their objectives, knowledge, task representation, individual preferences and choices. Typically, what is "shared" among group members will more strongly affect a group's decision than that which is not shared (Kerr & Tindale 2004). For example, information items that are known by all group members at the outset of a group decision process usually have more impact on group decisions than unique, unshared information items (Stasser, 1992; Gigone & Hastie, 1997); shared information items not only have more impact on the group members` individual decisions but are typically also more likely to be mentioned during discussion (Winquist & Larson, 1998). This impact of sharing is not just restricted to the distribution of factual knowledge, but also pertains to the sharing of concepts, preferences, and individual choices. As a consequence of this common knowledge effect (Gigone & Hastie, 1997), decision tendencies that are predominant among individuals are often enhanced or accentuated in groups (e.g., Reimer et al. in press).

3.0 Fundamental Topic Areas in Group Decision Research

3.1. Group Size and Composition

While households are commonly thought of as two adult individuals, this need not be the case for many decision contexts. Therefore, group size and composition will affect decision making even in households. The composition of the group, including gender composition (Wood, 1987), can affect the degree to which the group shares a common frame of reference for processing information. Larger groups have greater capacity for attending to and storing information, which may be offset by distractions, inefficiencies, and other process losses (Hinsz, 1990; Steiner 1972).

Such process losses highlight the observation that larger groups generally are different than smaller groups in dimensions other than size. Costs of coordinating group deliberations, the nature of conflicts and incentives for cooperation, the types of problems likely to be evaluated and other factors vary in complex ways with group size and composition (Snidal 1995). Researchers often assume that size is related to the homogeneity of the group. However, even in groups as small as households, members may differ dramatically in terms of preferences, endowments, expertise, influence, and cognitive ability.

Sorkin et al. (2004) report results from both thought experiments and empirical experiments on how size and heterogeneity affect group detection and processing of information signals. Interestingly, they find that group-level signal-detection accuracy generally increases with group size, but the efficiency of individual signal-detection accuracy decreases with group size. In simulations with a jury model they find that, controlling for distribution of juror expertise and bias, larger juries reach correct conclusions more frequently than smaller juries, particularly under a unanimous voting rule.

A major strand of analysis in economics, social psychology, and even biology employs game-theoretic methods to evaluate outcomes of interdependent decision making (Franzen 1994; Colman 1995). Chamberlin (1974), for example, generalizes Olson's analysis to identify reaction-function conditions under which provision of an imperfect collective good actually increases with group size. Haag and Lagunoff (2003) identify the effects of group size and time-preference heterogeneity on an n-person generalization of the Prisoner's Dilemma game. This study confirms Olson's conclusion that larger groups deter cooperative outcomes when members are uniformly "impatient" about the future. As the prevalence of "patient" attitudes toward the future increases, however, the likelihood of cooperative equilibria increases.

3.2. Task Structure

The aggregation rule that is used by a household typically depends on the task structure. First, the task determines the set of strategies that can be applied. For example, an averaging rule requires the format of a continuous variable (e.g., making investments), whereas a majority rule – which may not be common in household choices – requires that a group be able to choose among different alternatives (e.g., purchasing a car). Second, empirical studies suggest that groups adapt the strategy they use to the task at hand: when faced with a preference task, groups often apply a majority or plurality rule; in contrast, when faced with an inference task, groups often apply a “truth-wins” principle if the members who are correct are able to demonstrate the correctness of their inference (Laughlin & Ellis, 1986 and Hinsz et al. 1997). The “framing” of the decision problem as preference or inference tasks can occur exogenously to the household, or it may be recast endogenously. Household decisions like purchasing a car are typically composed of both kinds of decision tasks. Furthermore, some groups may interpret a decision as an inference problem while other groups may interpret the same decision as a preference problem.

However, the correctness of an inference often cannot be "proven" by any group member, in particular because inference decisions are often based on noisy or incomplete information. Then, group decisions may be better described by a signal detection approach. In the terminology of signal detection theory, a decision maker makes an inference decision by first making an (noisy) observation of the situation and then deciding on which input condition led to the observation. An outcome payoff (or penalty) is tied to each combination of input condition and decision. Many inferential decision tasks can be described using a standard signal detection paradigm: detection (presence or absence of a signal in noise), discrimination (one of two alternative signals), or identification (one-of-*m*-alternative signals). Important model parameters include the decision maker's ability to discriminate among the possible inputs, memory uncertainty about the signal characteristics, and response biases toward the decision outcomes (i.e., a function of the event probabilities and outcome utilities). The detection approach simplifies the measurement of decision performance (accuracy and bias) and in many situations allows specification of optimal behavior. Ideal models of detection have been used to describe the behavior of groups of human decision makers (Pete et al. 1993; Sorkin et al. 2001).

3.3. Shared versus Conflicting Objectives

An important point for interpreting the literature and formulating models of household decision-making is the extent to which group members have consistent or conflicting objectives. For instance, in Reimer and Katsikopoulos (in press), group members were each paid 3 euro cents for each correct answer by the group. Due to the incentive structure, we expect members to share a consistent/common objective of obtaining as many correct group responses as possible. The degree to which members of the group share an overall objective may quickly degrade in real world situations, however. For instance, for a household evaluating vacation options, all group members might agree that a warmer locale and cheaper lodging are better, yet by differentially valuing warmth and costs they might individually prefer different alternatives. The point here is that shared objectives in real household decision-making may not exist in the same way they can be constructed in an experimental setting. Even though many households are hopefully characterized as embodying a high degree of care and concern for its members well-being, real choices from multiple alternatives with multiple attributes are challenging precisely because there may not be a single shared objective. In moving from experiments to modeling real household decisions we have to be careful to draw upon the experimental literature while recognizing that decision-making rules for households must contend with additional challenges. We return to this idea in section 4, where we sketch some formal models.

3.4. Choice Sets

In many household decision problems involving multiple alternatives and multiple attributes, groups may reach decisions in a phased approach: first, they construct/negotiate a subset of alternatives that appropriately reflect individual constraints, requirements, concerns and preferences – call this *choice set formation*; second, choice is exercised from this (potentially) reduced and most acceptable set of alternatives according to some choice rule – call this *conditional choice*.

Not only does the choice set formation stage allow for the representation of member-level constraints (e.g., vacation durations) and requirements (e.g., the site must be no more than 1 day's travel from home), it also allows for the existence of altruism (e.g., parental support for inclusion of children's activities in the alternatives to be further considered) and other forms of interdependent decisions. Choice set formation may also be an interesting mechanism to capture the essence of group negotiations, to the extent that negotiations lead to a subset of available alternatives that group members find acceptable, though not necessarily individually optimal.

3.5. Aggregation Mechanisms

Group decision strategies can be classified on the basis of several dimensions: (a) the aggregation level, e.g., whether they aggregate across individual choices (social combination approach) or across cues/attributes (social communication approach); (b) the task they can solve; (c) their performance with regard to an outside criterion or a benchmark; (d) the decision costs involved and their frugality. We explore these aggregation mechanisms more formally in Section 4 below.

In addition to suggesting important parameters of the group and the decision situation, statistical models of the aggregation mechanism can provide insight into the decision processes used by human groups (Genest and Zidek 1986; Pete et al. 1993; Clemen and Winkler 1999). For example, the degree to which group members' observations (or noise) are correlated will have a negative effect on the accuracy of group performance. When aggregating the continuous estimates of its members, some human groups appear to be reasonably efficient relative to the optimal (Sorkin et al. 2001). However, less efficient aggregation may occur when a group must weigh discrete estimates from members having different levels of expertise and bias.

The nature of group member interaction may be an important factor in the effectiveness of the group's aggregation process (Gigone and Hastie, 1997). In some cases, near-optimal performance may be achieved by use of a simple unweighted aggregation rule (K of N majority) combined with a deliberation process that involves the iterated exchange of member opinion

(Swaszek and Willett, 1995). Sorkin et al. (2004) argue that the efficiency of the standard U.S. jury is due to the use of a unanimous majority rule; this rule forces longer deliberation and results in near-optimal detection performance by simulated juries.

4.0 Mathematical Modeling Approaches to Household Decision-making

4.1. Models of Group Choice

4.1.i. Linear Combination Random Utilities

The basic econometric analysis of individual choice data begins with the familiar random utility model. Following tradition, we define the utility *U* for alternative *j* for person *i* as random depending upon a deterministic component *V* and an error term *ε*, thus:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \ . \qquad (1)$$

We can generally interpret V_{ij} as the conditional mean of U_{ij} (up to a constant term). In the basic model, V_{ij} may depend upon the characteristics of the alternative and the decision maker, and is typically specified as linear-in-parameters with $V_{ij} = X_{ij}\beta$, where the *Xs* are attributes of the decision maker or alternative and the βs are unknown parameters. According to the basic random utility model for the choice of a single option among many, individual *i* chooses alternative *j* iff $U_{ij} > U_{ik}, \forall k \neq j$. We denote the probability of person *i* choosing alternative *j* as P_{ij}. Given the error terms in (1), choice is inherently probabilistic either because the individual behaves in a nondeterministic fashion, or because the researcher cannot assess an individual's utility with certainty. The unitary model described above is a model in which a single individual, *i*, chooses on behalf of a group operating under a single pooled budget constraint.

In the context of group decision-making it is often useful to leave out the individual decision maker's index and only consider one random variable U_j for the population-level random utility of option *j*. Such a distribution free random utility model usually works with the left hand side of (1) only, thus treating the variability of utility as substantive rather than due to random error. This approach is useful for quantifying the distribution of utilities across actors, with individual actors being probabilistic or deterministic. In such a model, $P(U_j = \max_{k \neq j} U_k)$ may be interpreted as the probability that a randomly drawn decision maker assigns *j* the highest utility. A special case, relevant to social choice theory, is a finite population of decision makers who have deterministic utility functions, where the above probability is simply the proportion of decision makers who assign *j* the highest utility.

Returning to the model that assigns each decision maker a random utility for each choice option, in two-person choice we need to specify what is aggregated to form one choice based on two people's preferences. The simplest model is that the utilities are aggregated in an additive way, as proposed by Arora and Allenby (1999) (see also Zhang et al. 2004). Writing U_j^* for the aggregate group utility of option *j*, Arora and Allenby's basic idea is that $U_j^* = \alpha U_{1j} + (1-\alpha) U_{2j}$ and alternative *j* is chosen by the group iff $U_j^* > U_k^*, \forall k \neq j$. In this model, a weighted average of the two individuals' utilities is taken, α being the weight (α may or may not be restricted to the interval [0,1]). The form of the model is the same as in (1), which suggests that when utilities are combined in such a linear fashion, one can treat dyad choices in the same manner as individual choices (with perhaps some loss of efficiency). That is, the group decision looks as though a "representative agent" made the choice. Expanding on Arora and Allenby's model, a more general linear combination model would state that $U_j^* = \Sigma_i f(i) U_{ij}$, with $\Sigma_i f(i) = 1$. Without further details, we note here that this class of models, like most discrete choice models, suffers from a number of parameter identification issues.

The models above are obviously extreme simplifications of the actual group decision process. More realistic models would specify random utilities as stochastic functions of time, the context of the decision task, the composition of the decision-making group, and the set of available choice options, among other factors. Furthermore, a realistic model may require specifying the contribution to utility of each relevant attribute of choice options. Some of these components of household decision-making, in turn, are likely to form interdependent, stochastic processes in their own right. Furthermore, decision tasks often require first choosing a consideration subset of possible alternatives and sometimes require full or partial ranking of alternatives.

Aggregation rules often assume utility functions that are scalable at least at the interval scale level. Note that when the aggregation function is nonlinear in individual utilities, then dyad choice can not be depicted as a choice by a representative agent. Aggregation methods that only require ordinal rankings from the individual decision makers are attractive candidates for descriptive models of actual household decision-making because they (1) place comparatively low demands on decision makers' computational abilities, (2) avoid the representative agent approach to modeling household decision-making, and (3) are a straightforward generalization of the unitary model.

4.1.ii. Aggregation over Objects, Attributes and Decision Makers

A comprehensive theory of household decision-making should take into account the need to aggregate decision problems in multiple dimensions. For instance, in many household decisions, such as choosing a new car, preferences over consideration sets must be aggregated over household members. Determining the relative contributions each household member will make at various stages of the decision-making process, and even whose preferences are relevant, also must be aggregated over household members. Furthermore, any aggregation rules must be evaluated as dynamic, iterative and interactive processes.

We sketch the basic ingredients of a possible general mathematical model for household decision-making and illustrate them with a household car purchase. Let *t* denote the time point at which we consider the decision/deliberation process, O_t the set of available choice options at time *t*, A_t the set of relevant attributes at time *t*, and D_t the set of relevant decision makers at time *t*. Let $O = \bigcup O_t$, $A = \bigcup A_t$, and $D = \bigcup D_t$ denote the master sets of choice options, attributes and decision makers. A household choice function at time *t* is a mapping

$$\begin{aligned} c_t &: (O, A, D) \rightarrow 2^O \\ (O_t, A_t, D_t) &\mapsto c_t(O_t, A_t, D_t), \end{aligned} \qquad (2)$$

which maps the available options, relevant attributes and decision makers into a subset of objects. The set O_t may be a continuum or a discrete set. Over time this may be a consideration set, leading to an actual purchase at some final time point, such as, e.g., the first time point t^* for which the value of c_{t^*} is a single element set. We think of the collection of relevant attributes A_t as consisting typically of some cardinal attributes (e.g., price), some ordinal attributes (e.g., safety) and some categorical attributes (e.g., color). Furthermore, some of these attributes may be preference attributes (e.g., color), while others are inference attributes, with the latter being subdivided into intellective (e.g., financing cost) and signal detection attributes (e.g., safety). Similarly, the set of decision makers D_t may evolve over time and be subdivided into different categories; e.g., children might be involved in developing consideration sets, while the final car purchase decision might be made by the adults.

To sketch a general random utility model we first introduce individual random utilities of the relevant decision makers $d \in D_t$, denoted as $U_{d,S,t}(O_t, A_t, D_t)$, which depend on the available options, attributes and decision makers. The aggregate household random utility $U^*_{S,t}$ for choice set $S_t \subseteq O_t$ at time *t* is a function of the individual random utilities, i.e., $U^*_{S,t} = F\left(U_{d,S,t}(O_t, A_t, D_t)\right)$. For instance, generalizing Arora and Allenby (1999), *F* may be a linear function $U^*_{S,t} = \sum_d f(d) U_{d,S,t}(O_t, A_t, D_t)$. The household choice function at time *t* may then be defined as a random variable satisfying

$$c_t(O_t, A_t, D_t) = S' \Leftrightarrow U^*_{S',t} = \max_S U^*_{S,t}. \qquad (3)$$

In our car example, a purchase might occur at the first time point for which a single car has maximum household utility. Clearly, a model of this complexity introduces insurmountable identification issues, and only special cases can realistically be investigated.

4.2. Why Different Aggregation Mechanisms?

How knowledge is distributed among group members can strongly affect group choices even if the total set of information items known to the group is held constant. Typically, a group as a whole has more knowledge than does each of its individual group members (i.e., some information is unshared), but group members only rarely exchange all their knowledge (Stasser, 1992); thus, different distributions of information can yield different decisions. However, as in individual decision-making, the outcome also depends on how the available information is integrated into a joint decision (Reimer & Hoffrage, 2004).

Strategies also differ with respect to their frugality – the number of information items that are processed, and with respect to their complexity – the number of operations that have to be performed consecutively. Information load as well as the number of operations that have to be executed affect the costs of a decision (see Rieskamp & Hoffrage, 1999). Astonishingly, many decision tasks can be solved by fast and frugal heuristics without a severe loss in accuracy (see

Gigerenzer, in press). These heuristics work also very well in classic group tasks (Reimer & Hoffrage, 2004). Frugal decision strategies are in particular likely to be used under time pressure or when information search is costly (see Rieskamp & Hoffrage, 1999; Reimer & Katsikopoulos, in press).

5. Research Questions

Many questions arise in attempting to understand household decisions. Do households use frugal decision strategies that limit information processing? Do they apply satisficing algorithms by excluding alternatives that do not fulfill a certain threshold? The strategies implied by modeling efforts will result in different levels of success in predicting behavior – can this information be used to assess the "true" strategies employed by households?

Households may differ from groups that have been typically used in group research, which suggests the need for specially focused research efforts on household decision making. Group decision-making has been most often studied in the laboratory using ad-hoc groups that do not have a common history and future (see Hinsz et al. 1997). In contrast, members of a household may have (correct or incorrect) knowledge about their partner's preferences and expertise; they are typically faced with recurrent decision-making tasks, which may be solved by routines and meta-strategies.

A common question is whether or not household decisions can be measured by interviewing randomly picked individuals. To answer this it is important to have more knowledge pertaining to how households form their decisions. Empirical studies have shown that people tend to use their own behavior to describe their spouses' tactics, to thus influence joint economic decisions. This can yield accurate predictions when the similarity in actual behavior is high. But who will dominate if similarity is low?

It is surprising that relatively little research has been focused on modeling household or group decision making, especially given the importance of household choices. We expect that in the future the availability of household level data and advanced statistical models will help in assessing some of the questions we raise. However, while some of the challenges are associated with data and modeling capability, the most vexing challenges are to understand group decision strategies and the factors influencing these choices of strategies, in particular, decision contexts.

References

Andreoni, James (1990) "Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving," *Economic Journal*, June, *100*, 464-477.

Arora, N. and G. Allenby (1999) “Measuring the Influence of Individual Preference Structures in Group Decision Making,” *Journal of Marketing Research,* v. 36: 476-487.

Arrow, K. J. (1951). *Social Choice and Individual Values*. Wiley, New York.

Black, D. (1958). *The Theory of Committees and Elections*. Cambridge University Press, Cambridge.

Becker, Gary S. (1991) *Treatise on the Family*. Cambridge: Harvard University Press, 1981, Enlarged Edition.

Bergmann, Barbara R. (1995) "Becker's Theory of the Family: Preposterous Conclusions, " *Feminist Economics* 1:141-150.

Chamberlin, John (1974) "Provision of Collective Goods as a Function of Group Size." *The American Political Science Review*, June, 68:2 (June), 707-716.

Clemen, R. T., & Winkler, R. L. (1999). Combining probability distributions from experts in risk analysis. *Risk Analysis*, **19**, 2, 187-203.

Colman, Andrew M. (1995) *Game Theory and its Applications in the Social and Biological*

Sciences, Second Edition, Oxford: Butterworth-Heinemann.

Franzen, Axel (1994) "Group Size Effects in Social Dilemmas: A Review of the Experimental Literature and Some New Results for One-Shot N-PD Games." In *Social Dilemmas and Cooperation*. U. Schulz, W. Albers, and U. Meuller, eds. New York: Springer-Verlag.

Genest, C. & Zidek, J. V. (1986). Combining probability distributions: A critique and an annotated bibliography. *Statistical Science,* **1**, 114-148.

Gigerenzer, Gerd (in press). Bounded rationality: The study of smart heuristics. In D. Koehler & N. Harvey (Eds.), Handbook of judgment and decision making. Oxford: Blackwell.

Gigone, D., and Hastie, R. (1997). Proper analysis of the accuracy of group judgments. *Psychological Bulletin*, **121**, 149-167.

Haag, Matthew and Roger Lagunoff (2003) "On the Size and Structure of Group Cooperation." Fondazione Eni Enrico Mattei Working Paper. June 2003.

Hinsz, Verlin B. (1990) "Cognitive and Consensus Processes in Group Recognition Memory Performance." *Journal of Personality and Social Psychology* 59:705-718.

Hinsz, Verlin B., R. Scott Tindale, and David A. Vollrath (1997) "The Emerging Conceptualization of Groups as Information Processors." *Psychological Bulletin* 121(1):43-64.

Kerr, N. L., & Tindale, R. S. (2004) Small group decision making and performance. Annual Review of Psychology, 55, 623-656.

Kirchler, E. (1988) Household economic decision-making. In W. F. van Raaij, G. M. van Veldhoven, T. M. M. Verhallen & K.-E. Wärneryd (eds.). Handbook of Economic Psychology. Amsterdam: North Holland.

Kirchler, E. (1999) Household decision making. In P. E. Earl & S. Kemp (eds.), The Elgar Companion to Consumer Research and Economic Psychology (pp.296-304). Cheltenham, UK:

Edward Elgar.

Laughlin, R. P., & Ellis, A. L. (1986) Demonstrability and social combination processes on mathematical intellective tasks. Journal of Experimental Social Psychology, 22, 177–189.

McLean, I. and Urken, A. B. (1995) *Classics of Social Choice*. Michigan University Press, Ann Arbor, Michigan. Edited and translated text of classical papers on social choice.

Olson, Mancur (1965) *The Logic of Collective Action: Public Goods and the Theory of Groups*, Cambridge Mass.: Harvard University Press.

Pete, A., Pattipati, K.R., & Kleinman, D.L. (1993) Optimal team and individual decision rules in uncertain dichotomous situations. *Public Choice*, **75**, March, 205-230.

Pollak, Robert A. (2003) "Gary Becker's Contributions to Family and Household Economics," *Review of Economics of the Household* 1:111-141.

Regenwetter, M., Grofman, B., Marley, A., and Tsetlin, I. (forthcoming). *Behavioral Social Choice*. Cambridge University Press, Cambridge.

Reimer, T., Bornstein, A.-L., & Opwis, K. (in press). Positive and negative transfer effects in groups. In T. Betsch & S. Haberstroh (Eds.), Routine Decision Making. Mahwah, NJ: Erlbaum.

Reimer, T., & Hoffrage, U. (2004) *The ecological rationality of simple group heuristics.* Center for Adaptive Behavior and Cognition, Max Planck Institute for Human Development.

Reimer, T., & Katsikopoulos, K. (in press). The use of recognition in group decision-making. *Cognitive Science*.

Rieskamp, J., & Hoffrage, U. (1999) When do people use simple heuristics, and how can we tell? In G. Gigerenzer, P. M. Todd, and the ABC Research Group, *Simple heuristics that make us smart* (pp. 141–167). New York: Oxford University Press.

Saari, D. G. (2001) *Decisions and Elections: Explaining the Unexpected*. Cambridge University

Press, Cambridge.

Sen, A. K. (1966) A possibility theorem on majority decisions. *Econometrica*, 34:491-499.

Snidal, Duncan. (1995) The Politics of Scope: Endogenous Actors, Heterogeneity and Institutions." In *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains*. Ed. Robert Keohane and Elinor Ostrom, 47-70. London: Sage.

Sorkin, R. D., Hays, C.J., & West, R. (2001) Signal detection analysis of group decision making. *Psychological Review,* **108**, 183-203.

Sorkin, R. D., Luan, S., & Itzkowitz, J. (2004) Group Decision and Deliberation: A Distributed Detection Process. Chapter 23 in D. Koehler & N. Harvey, (Eds), *Handbook of Judgment and Decision Making.* Oxford: Blackwell (in press).

Stasser, G. (1992) Information salience and the discovery of hidden profiles by decision-making groups: A "thought experiment". Organizational Behavior and Human Decision Making, 52, 156-181.

Steiner, I.D. (1972) *Group Process and Productivity*. New York: Academic Press.

Swaszek, P. E., & Willett, P. (1995) Parley as an approach to distributed detection. *IEEE Transactions on Aerospace and Electronic Systems*, **31**, 1, 447-457.

Vermuelen, F. (2002) Collective Household Models: Principles and Main Results. *Journal of Economic Surveys*. (16): 533-564.

Wood, W. (1987) A Meta-Analytic Review of Sex Differences in Group Performance. Psychological Bulletin 102:53-71.

Zhang, J., H.J.P Timmermans, A.W.J. Borgers (2004) A model of household task allocation and time use, *Transportation Research Part B.* vol 38.