



More than thirty years of ultimatum bargaining experiments: Motives, variations, and a survey of the recent literature[☆]



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ABSTRACT

Take-it or leave-it offers are probably as old as mankind. Our objective here is, first, to provide a, probably subjectively colored, recollection of the initial ultimatum game experiment, its motivation and the immediate responses. Second, we discuss extensions of the standard ultimatum bargaining game in a unified framework, and, third, we offer a survey of the experimental ultimatum bargaining literature containing papers published since the turn of the century. The paper argues that the ultimatum game is a versatile tool for research in bargaining and on social preferences. Finally, we provide examples for open research questions and directions for future studies.

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1. Introduction

If one searches for “ultimatum bargaining” on <http://scholar.google.com/>, there are more than 26,500 results. The first result is the original article by Güth et al. (1982) that is cited around 3000 times. The ISI Web of Knowledge counts more than 1000 citations for this paper.² An entire generation of behavioral and experimental economists as well as psychologists has been influenced by the result that people systematically deviate from the prediction of ultimatum bargaining based on payoff maximization. Thousands of ultimatum game experiments and extensions have been published in the meantime. More than thirty years after the publication of the first ultimatum bargaining experiment it is time to take stock.³

[☆] In the context of a presentation, Uri Gneezy suggested writing a survey of more than 30 years of ultimatum bargaining research. We thank him for the nudge, Martin Dufwenberg, Sabine Kröger, Axel Ockenfels, and two anonymous referees for very helpful suggestions to improve this survey, and David Bauder as well as Niklas Garnadt for excellent research assistance. We are extremely grateful to the magnificent members of the Economic Science Association Discussion List; many of them – too many to mention all of them here – pointed us to scholarly papers that use the ultimatum game. All remaining errors and omissions are of course ours.

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² The number of citations is only an imprecise measure of a paper's influence on a profession, especially once a concept has become as widely used as the ultimatum game. Many references to the game do not cite the original paper anymore.

³ Earlier surveys are Güth and Tietz (1990), Güth (1995), Roth (1995), Camerer (2003), and chapters 46, 47 as well as 50 in Plott and Smith (2008); all with a different focus than this one.

It seems impossible to survey in one paper the entire literature on ultimatum bargaining and on experiments using the ultimatum game. The sheer size of the literature forces us to pursue a more moderate approach. In contrast to a more traditional survey paper, the objective of this paper is threefold. First, it is intended to provide a, probably subjectively colored, recollection of the initial ultimatum game experiment, its motivation and immediate responses to its publication. Second, we discuss some influential extensions of the standard ultimatum bargaining game, and, third, we offer a survey of the experimental ultimatum bargaining literature containing papers published since the turn of the century; and only the last one is already a task that forces us to be eclectic in what we can cover.

We remember a discussion in which it was claimed that the ultimatum game is one of the behaviorally most complex games in experimental economics, much more complicated than games with many players, potentially incomplete information, and/or mixed strategy equilibria.⁴ It is a statement that requires second thought: while the game structure is obviously one of the easiest that can be imagined (two players, two stages, complete information), the motivations behind decisions in the ultimatum game are diverse, and it took researchers some time to understand them.

At the outset of the experimental research on ultimatum bargaining, toward the end of the 1970s and the beginning of the 1980s, the source for the interest in the ultimatum game was to study bargaining and to document limits of the traditional assumptions regarding rationality and material selfishness or opportunism. Whereas social dilemma games such as the prisoners' dilemma and the public goods game explore the efficiency of strategic interaction outcomes, the findings of ultimatum experiments more fundamentally challenge the narrow concept of material opportunism, namely that decision makers maximize their own payoff in each and every situation. Behaving non-optimally in this sense in social dilemma games can be explained by efficiency concerns. However, in ultimatum games where responders reject positive offers, i.e., they essentially “burn money”, potential efficiency concerns are also violated. Thus, the results from ultimatum experiments reject the narrow orthodox assumption of material opportunism, but they do not necessarily reject rationality in a broader sense, allowing for all sorts of aversion concepts, intrinsic motivations, other-regarding preferences, and emotions. As a consequence, there was much room for research from different perspectives.

There are still open questions in the context of the ultimatum game after more than thirty years of research. Especially, it seems difficult to predict individual behavior in the game, based on observables. Thus, a “ban on ultimatum experiments”, as Camerer (2003) not entirely seriously asks for, seems premature. As will become clear below, beyond its immediate function as a test of specific aspects of bargaining theory, the ultimatum game has become a valuable tool or workhorse for studying a host of different research questions in economics and in other disciplines.

The remainder of the paper is organized according to what we see as the three phases⁵ the ultimatum game underwent since its implementation. The first phase is related to the game as being able to show that some assumptions in the theory at that time were not adequate to capture observed behavior. In this spirit, Section 2 traces the first theoretical discussion of ultimatum bargaining (Güth, 1976), before discussing in more detail how this has inspired the first ultimatum experiments, especially by confronting them with earlier experiments of bargaining and negotiations. Section 3 recollects the main findings of Güth et al. (1982) and discusses why they have received attention and inspired many subsequent studies. The second phase was concerned with “explaining” behavior in the ultimatum game. Section 4 tries to provide some of these explanations; it is mainly devoted to relevant earlier modifications of take-it or leave-it offer bargaining. Since the surveys mentioned in footnote 3 do a great job in giving an overview of explanation attempts, we can be brief here. In Section 5, we mainly focus on scholarly contributions using the ultimatum game after the turn of the century – a time span that has not been surveyed well so far. Section 5 provides both examples for the second phase and a third phase, in which the ultimatum game became a general “workhorse” for studying social and psychological phenomena. In Section 6, we discuss some possible directions of future research, and Section 7 concludes the paper.

2. How it began

Having studied economics intensified Werner Güth's interest in fairness which he wanted to analyze game theoretically. In spite of the – at that time – still predominant cooperative game theory, he was interested in strategic games generating fair and efficient outcomes (see Güth, 1976, for early attempts). As most game theorists of that time, he was aware of alternating concession models (Zeuthen, 1930) and how they are related to Nash's (1950) bargaining solution (Harsanyi, 1959) and of alternating offer bargaining models (Ståhl, 1972).

One problem of the latter paradigm is that it appeals to often observed alternating concessions or agreement offers, although its solutions predict an immediate agreement due to the efficiency loss by delayed conflict resolution. Allowing for just one round of take-it or leave-it offers avoids the problem, but this was no essential reason for being interested in ultimatum bargaining at that time. Undoubtedly, there was an awareness of the active research in characteristic function experiments (see, for example, Sauermann, 1972), which were usually run “face-to-face” and with free-from communication. Such protocols obviously allow for all sorts of confounding effects from physical attraction, signaling, beliefs on trustworthiness, to prior acquaintance, which Werner Güth aimed to avoid or at least reduce as much as possible in his setup. But,

⁴ Amnon Rapoport made this claim in a conversation.

⁵ We are grateful to an anonymous referee who made explicit reference to the three phases.

although – thanks to his close relation to Reinhard Selten – he was quite familiar with the experimental method, it needed some “seduction” to make him study “ultimatum bargaining” (see Güth, 1976) experimentally.

Werner Güth mainly wanted to use a strategic model of bargaining and focus, for a start, on the simplest model of take-it or leave-it offers, with the option to later enrich it, e.g. by allowing for more complex choice sets or for more rounds of take-it or leave-it offers by the same party or with both parties alternating. The intuition that this might be an interesting topic for experimental research may have been inspired by the evidence of fair outcomes in the early dictator game or in reward allocation experiments (for example, Mikula, 1973; Shapiro, 1975). Could such fairness be observed also when allowing for the most elementary form of strategic interaction?

In September 1977 (Werner Güth's first month as a professor of economics at the University of Cologne), Wulf Albers and Günther Bamberg organized a workshop bringing together game theorists and social psychologists and trying to promote experimental research. They did so by offering funds for running experiments. Werner Güth got 1.000 German marks and immediately started preparing the first experiments, the ultimatum bargaining study reported in Güth et al. (1982) as well as an auction experiment described in Güth et al. (1983).

Two students (Rolf Schmittberger and Bernd Schwarze⁶) helped to run the experiments and also typed the many versions of the manuscript before the paper was finally published.

3. The first findings

The ultimatum game features a situation in which one party specifies all details of an agreement, and the other party can either accept or reject, where rejections imply that the surplus of the deal is lost.⁷ What renders the ultimatum game special, also when compared to principal-agent models, is its constant-pie-assumption. This means that the main concern of the game is how to distribute the rewards and that inefficiency can only be caused by rejection, i.e., by not reaching an agreement.

More formally, let X be the proposer who suggests the shares x and y for him or her and the responder Y , respectively, where x and y are non-negative and add up to the positive pie size p . First, X chooses (x, y) with $x, y \geq 0$ and $x + y = p$. Then, after learning the choice of (x, y) by X , responder Y either accepts, $\delta(x, y) = 1$, or rejects, $\delta(x, y) = 0$. This implies the final payoffs $\delta(x, y)x$ for X and $\delta(x, y)y$ for Y .

Material opportunism requires that any positive actual offer y to Y must be accepted by Y , i.e., $\delta(x, y) = 1$ for $y > 0$. On the one hand this, however, does not exclude the existence of a large multiplicity of equilibria, for example, of the form $((x, y), \delta(\tilde{x}, \tilde{y}) = 1 \text{ if } \tilde{y} \geq y \text{ and } \delta(\tilde{x}, \tilde{y}) = 0 \text{ otherwise})$ for all y with $0 \leq y \leq p$. On the other hand, the elimination of weakly dominated strategies implies $\delta(x, y) = 1$, whenever y is positive. If this is anticipated, a selfish and rational proposer X should offer responder Y at most the smallest positive amount.⁸ Thus, repeated elimination of weakly dominated strategies implies that proposer X receives nearly all of p and responder Y at most the smallest positive amount. The same solution is implied by (subgame) perfectness of equilibria (Selten, 1965, 1975).

As a consequence, the empirical finding of the modal offer $y = p/2$ seemed less troublesome for the standard assumptions in game theory at that time (see Aumann, 1974, who propagates coarsening rather than refining the equilibrium concept) than the observation that low offers, for example in the region $y < p/3$, are sufficiently often rejected to render such low offers unattractive for proposers. The rejection of positive offers y clearly questions material opportunism. At first sight the rejections might seem explainable by noise, mistakes, or confusion, but the systematic structure of them makes it difficult to sustain such explanations.⁹

Importantly, the modal equal split offer is an extremely robust phenomenon. On average, **players in the game tend to offer around 40–50% of the pie in the standard version of the game**. Such offers are almost always accepted. Responders' acceptance rates decrease with smaller offers, and they **approach zero quite quickly for offers below 20%**. From an ex post perspective, taking actual rejection rates into account, either the equal split or offers around 40% are payoff maximizing for proposers (see Camerer, 2003). Most responders exhibit monotonic rejection strategies, although one consistently observes a small number of rejections of rare “superfair” offers with $y > p/2$ (Güth et al., 2003).¹⁰

The evidence from the ultimatum game implies that, first, responders do not only care about their own monetary payoff but compare their payoff with that of the proposer and become frustrated when their share is much lower. Second, proposers are either aware of the responder's willingness to reject unfair offers or guided by own fairness concerns when offering sizable or even fair¹¹ shares for Y .

⁶ Bernd Schwarze finally wrote a Ph.D. thesis in experimental economics (Schwarze, 1983; see also Güth and Schwarze, 1983).

⁷ Güth (1976) also discussed (von Stackelberg) situations where not all details of the agreement could be specified and some could be chosen by the responder (see Siegel and Fouraker, 1960, for an early experiment of such a situation).

⁸ Since both, $\delta(p, 0) = 1$ and $\delta(p, 0) = 0$, are optimal, there is indifference in case of zero offers.

⁹ Rationality in making mistakes, for example by assuming that less costly mistakes are more likely (Myerson, 1978), could account for more likely rejection of lower offers but not for the very high rejection rates of substantial, but unfair offers.

¹⁰ Assuming monotonicity allows eliciting responders' behavior by asking them for a minimum acceptable offer (MAO). Methodologically, it might sometimes be helpful to give no information about proposals to responders at all. Eliciting MAOs allows to ask for proposals and responder behavior simultaneously, without explicitly having to use the strategy vector method.

¹¹ We define the equal split (i.e., an offer of $y = p/2$) as fair.

In the spirit of the earlier reward allocation experiments it seemed that participants assumed equal “contributions” (since the pie was given to them like “manna from heaven”, i.e., as a windfall gain) and therefore wanted to share it equally.¹² As in almost any experimental game, behavior is very heterogeneous across decision makers. Some of the participants in the experiment engage in backward induction and more often than not fail in reaching an agreement by not figuring out that its result might not be socially acceptable. What is taught in a standard introductory game theory class or an operations research course may not be behaviorally optimal when fairness matters, i.e., when fairness is not taken into account in the utility function. Analytic capability is better paired with social intelligence.¹³

There is a second part of the Güth et al. (1982) paper that is hardly ever mentioned or referred to. It allows for a variable pie size by asking X to allocate two stacks of differently colored chips with different monetary chip values in two bundles for the two players. Y can choose the preferred bundle, and X obtains the other bundle. In what is coined the “complicated ultimatum game” in the paper, equality of monetary earnings could be achieved efficiently and inefficiently (see Nydegger and Owen, 1975, for an early experiment using asymmetric chip values). The intention of exploring the complicated ultimatum game was to show how the ultimatum game can be enriched in order to assess additional research questions such as, for example, whether decision makers are mainly interested in equality or in both, equality and efficiency.

Is it just the “manna-from-heaven” pie that triggers such strong fairness concerns? It definitely is responsible for observing $y = p/2$ as the modal offer but not for offering sizable amounts to the responder. Güth and Tietz (1985, 1986) provided entitlements over the endowment (see also Hoffman and Spitzer, 1985) by auctioning off the roles of proposers X and responders Y and observed hardly any equal split but splits of pie p in the range of $y = p/3$, in correspondence with the twice as high role prices of proposers X compared to those of responders Y in the auction. Hoffman et al. (1996) allocated roles by assigning participants with a better quiz score to the proposer role and could also confirm an entitlement effect,¹⁴ reducing the instances of equal sharing of p and triggering a self-serving bias on the side of the proposer participants (for more recent evidence, see e.g., Gächter and Riedl, 2005).

One general impact of the ultimatum game on research in economics tends to be easily overlooked. The ultimatum game has been relevant as an empirical example and as guidance for developing new theoretical models of other-regarding preferences. Even if his model concerns normal-form games, Rabin (1993) mentions the ultimatum game four times in his paper (excluding the reference list).¹⁵ Outcome-based models of other-regarding preferences are even more strongly influenced by the results from ultimatum bargaining experiments. Kirchsteiger (1994) mentions the game 29 times in his paper, Levine (1998) 37 times, Fehr and Schmidt (1999) mention it 27 times, and Bolton and Ockenfels (2000) 53 times. Not much lower are the numbers for Charness and Rabin (2002) with 17 times, Falk and Fischbacher (2005) with 25 times, and Cox et al. (2007) with 26 times.¹⁶ The impact of the ultimatum game results on the theoretical development of social preference models in behavioral economics was significant.

4. Let the game continue

In the following, we focus on three sets of relevant methodological extensions of the basic ultimatum bargaining game. Section 4.1 discusses alternating-offer bargaining and repeated play of the basic game; Section 4.2 provides a selection of modifications of the one-round game, and in Section 4.3, we give an overview of ultimatum game extensions that involve more than two players.

4.1. Multiple bargaining rounds

As an extension of the basic one-shot ultimatum game, multiple rounds of – usually alternating – take-it or leave-it offers were introduced in the experimental laboratory, based on the theoretical work by Ståhl (1972) and Krelle (1962) as well as Rubinstein (1982, 1985). The first such experiment (Binmore et al., 1985) confirmed the findings of Güth et al. (1982), but mainly discussed the results of a two-round alternating offer game with a second-round pie p_2 at the level $p_2 = p_1/4$, with p_1 denoting the first-round pie. In other words, in the design of Binmore et al. (1985) delaying an agreement implied an efficiency loss of 75%. The authors concluded from their findings that, except for the special case of one-round ultimatum offers,

¹² Speaking of “contributions” means to apply equity theory (see, for example, Homans, 1961) in a liberal way in order to make it applicable, even though contributions to generate the total reward are minor or even though they are only an aspect of belonging to the group of recipients.

¹³ Social intelligence is accumulated when growing up. The results from ultimatum games played by children and teenagers are somehow mixed, however (see Murnighan and Saxon, 1998; Hoffman and Tee, 2006; Sutter, 2006; Steinbeis et al., 2012). The general picture from economic experiments with children and adolescents (see also Kocher and Sutter, 2007) tends to support the hypothesis of a development of social intelligence when growing up leading to higher offers and less conflict with increasing age during childhood. When looking at results from experiments with chimpanzees (Jensen et al., 2007), it becomes evident that their behavior is closest to the model of a homo oeconomicus, even though fair sharing behavior has also been observed repeatedly in monkeys (see e.g., Horner et al., 2011).

¹⁴ In the sense that by one's relatively better quiz score one feels entitled to command ultimatum power rather than the other, but not in the sense that ultimatum power corresponds to the difference in “contributions”.

¹⁵ Dickinson (2000) uses an ultimatum game to test one aspect of Rabin's theory, i.e. that people care relatively less for fairness the higher the stakes in the game.

¹⁶ Empirically, the predictive power of models incorporating social preferences has been assessed using the ultimatum game (in combination with other games). Examples are Bolton and Ockenfels (2005) and Blanco et al. (2009).

game-theoretic backward induction based on standard preference assumptions provides a reasonable prediction, especially after allowing for some (minimal) learning. The conclusion inspired a very active strand of the literature in behavioral economics: alternating offer games, usually based on “shrinking pies”, i.e., costly delay.

One major result in this literature (see the early surveys of Güth and Tietz, 1990; Roth, 1995) is that backward induction, based on more or less commonly known material opportunism, is hardly ever in line with the experimentally observed behavior. This was most convincingly demonstrated first by using the mouse-lab technique (Johnson et al., 2002) revealing that when submitting earlier offers, participants have not yet retrieved the information on pie sizes in later bargaining rounds. However, proper backward induction requires knowledge of the pie sizes in later rounds.

Güth and Tietz (1985, 1986) questioned backward induction even for the simple case of two rounds, only by imposing either a radically shrinking pie ($p_2 = p_1/10$) or an almost not-at-all-shrinking pie ($p_2 = 9p_1/10$). The game-theoretic prediction that one party should get only one tenth of the initial pie p_1 was never implemented; especially first-round proposers nearly never accepted that they should receive less (as in case of $p_2 = 9p_1/10$, where the first-round proposer should demand only $1/10$ of p_1). Unfair first-round offers were rejected even when it was impossible to earn the offered amount in later rounds (see Ochs and Roth, 1989, and the discussion in Roth, 1995). Learning, for example by allowing to play, first, the last subgame, then, the second-to-last subgame etc. (see Neelin et al., 1998), usually does not lead to behavior consistent with backward induction.

Finally, delaying an agreement does not always have to be costly. When, for example, later agreements can be conditioned more specifically on environmental aspects, it may be helpful to wait before striking a deal. Güth et al. (1993) explored, first, in(de)creasing, then, de(in)creasing pie sizes in addition to the usual declining “pies” and found that participants usually strive for an agreement in rounds in which the pie size is maximal. Thus, it seems that decision makers are guided by strong equality as well as efficiency concerns.¹⁷

Another question that was of considerable interest in the 1980s and 1990s was learning in repeated play of the identical basic game. It was implemented using a stranger design (changing pairs) in order to avoid confounding reputational concerns among players with learning. Recently, Cooper and Dutcher (2011) provided evidence in a meta-study (see also Lin and Sunder, 2002) that behavior in repeated ultimatum games with stranger interaction seems similar to learning a norm, where offers have to hit some threshold to be accepted. With experience, acceptance rates of low offers even decline. Similarly, a recent learning experiment asking participants to play 100 rounds of a standard ultimatum bargaining experiment using a random strangers design revealed a very quick convergence to proposers offering and responders demanding an equal share (Avrahami et al., 2010).¹⁸

Gale et al.'s (1995) more general learning paper focuses almost exclusively on the ultimatum game, whereas Roth and Erev (1995) provide more general evidence of learning in extensive form games. Nevertheless, the ultimatum game was mentioned more than 60 times in their study. Even without looking at the large subsequent literature on learning in games, the influence of the ultimatum game becomes obvious.

4.2. Modifying the one-round game

Here we refrain from reviewing the large literature on dictator giving (see Roth, 1995; Camerer, 2003, for reviews). Mostly, studies confirmed the findings of the early reward allocation experiments (Mikula, 1973; Shapiro, 1975), i.e. that allocator participants are often guided by own intrinsic fairness concerns (Forsythe et al., 1994). However, dictator giving strongly depends on the details of the interaction (Cherry et al., 2002).

For the following overview of modifications of the standard ultimatum game, a more general characterization will be helpful in order to be able to classify different variants. Consider the following general setup: The responder's decision $\delta(x, y) \in \{0, 1\}$, about which the allocator X is informed, imply earnings $\delta(x, y)x + [1 - \delta(x, y)]\alpha x$ for proposer X and $\delta(x, y)y + [1 - \delta(x, y)]\beta y$ for responder Y , with $\alpha, \beta \in [0, 1]$. This apparently features the ultimatum game as a special case of a two-dimensional class of games with $\alpha = \beta = 0$.

Suleiman (1996) explored the subclass of $\alpha = \beta$ -games and showed that weaker veto power (i.e., larger $\alpha = \beta$ -parameters) suffices to induce fair outcomes.¹⁹ Fellner and Güth (2003) studied the subclass of $\alpha + \beta = 1$ -games in order to investigate different degrees of punishment efficiency and to supplement the earlier studies of corner games (see Bolton and Zwick, 1995; Güth and Huck, 1997) with $\alpha, \beta \in \{0, 1\}$, rather than $\alpha, \beta \in [0, 1]$. The general message of these studies is that even without punishment power ($\alpha = 1$), recipients can expect some generosity ($y > 0$), but that punishment efficiency, measured by the ratio of what X and Y lose in case of $\delta(x, y) = 0$, can be crucial. This ratio is partly endogenous and only partly dependent on the exogenously imposed parameters α and β , due to $\alpha x/\beta y$.

Another possibility to view the ultimatum game as a boundary case of a (this time one-dimensional) class of games has been theoretically and experimentally explored by Fischer et al. (2006). The game class is based on the assumption that both parties X and Y independently determine choices x , respectively y , satisfying $0 \leq x, y \leq p$, and that the implication of

¹⁷ Some more subtle aspects of alternating offer experiments are discussed in Roth (1995).

¹⁸ Learning speed in ultimatum games is discussed in Cooper et al. (2003). Armentier (2006) studies learning in an ultimatum game in which participants receive large and widely unequal initial endowments.

¹⁹ Güth and Kovács (2001) allow Y participants to buy veto power, in the sense of $\alpha = \beta < 1$ instead of $\alpha = \beta = 1$.

Y's "demand" depends on a chance move. The chance move determines whether (i) Y's "demand" serves as an acceptance threshold in the sense that Y gets $p - x$ if $p - x \geq y$ with conflict otherwise, or whether (ii) it is a demand, meaning that Y earns y if $x + y \leq p$ with conflict otherwise. Such a setup allows to continuously connecting the ultimatum game to the demand game, studied by Nash (1950), via the probability for (i) and the complementary probability for (ii). Applying equilibrium selection (Harsanyi and Selten, 1988), all games can be solved uniquely, showing how the solution outcomes vary continuously from full exploitation (y close to 0) to fair outcomes ($y = p/2$), when the probability for (ii) increases from 0 to 1. Behaviorally, however, equal splitting ($y = p/2$) is much more prevalent, as could have been expected from earlier ultimatum experiments.

Viewing the ultimatum game as a boundary case of a larger game class allows to compare different games experimentally by using the same verbal instructions and distinguishing treatments only by numerical parameters (α and β , or the probability for (i), respectively (ii) from above). Such an approach helps limiting implicit and explicit demand effects, and it helps applying and exploring the principle of approximate truth (Brennan et al., 2008) behaviorally, in order to investigate whether discontinuities result when parameters approach the limits.²⁰

Focusing again on the standard ultimatum game with $\alpha = \beta = 0$, a dramatic effect on the set of equilibria follows, when Y participants are not informed about the offer (x, y) chosen by their X participant. Imposing $p \geq y > 0$ means that Y should always accept ($\delta = 1$). Consequently, proposer X should only offer the smallest (positive) amount. The first laboratory study of the so-called Yes–No game confirmed the theoretical prediction for Y, however observed offers y lower than ultimatum offers but larger than dictator gifts (Gehrig et al., 2007). In contrast, a later study with two possible pie sizes elicited a few $\delta = 0$ reactions (Güth and Kirchkamp, 2012). The main reason for choosing $\delta = 0$ seems to be some form of group solidarity in the sense of "as responders, we once in a while should punish to prevent escalating exploitation by proposers", i.e., of responders voluntarily providing a "public good" for all Y participants via rejecting "the pig in the poke".

A more recent variation of the standard ultimatum game assumes that proposer X chooses the pie size $p \in [p, \bar{p}]$ from some generic interval with $0 < p < \bar{p}$. The choice can be accepted ($\delta(p) = 1$) or rejected ($\delta(p) = 0$) by responder Y, and the pie allocation is determined by imposing a positive agreement payoff for one party and featuring the other party as the residual claimant. In case of Y as the residual claimant, proposer X earns the exogenously given amount x and Y earns $y = p - x$ in case of $\delta(p) = 1$, whereas both earn nothing in case of $\delta(p) = 0$, i.e., X gets $\delta(p)x$ and Y earns $\delta(p)(p - x)$. Here, for example in Güth et al. (2012), the parameters satisfy $0 < x < p < 2x < \bar{p}$. In case of X as the residual claimant, the payoffs are $\delta(p)(p - y)$ for X and $\delta(p)y$ for Y, where now y is exogenously given, and one is naturally interested in the parameterization $0 < y < p < 2y < \bar{p}$. If Y is the residual claimant, the game is called "generosity game". In contrast, when X is the residual claimant, the game is named "envy game".

Both types of games are suited to assess the type and the strength of other-regarding concerns, especially of inequity aversion or equity liking (Homans, 1961; Loewenstein et al., 1989; Bolton, 1991; Bolton and Ockenfels, 1998, 2000; Fehr and Schmidt, 1999), or efficiency seeking (Charness and Rabin, 2002). Actually, the two-modal results are $p = 2x$, respectively $p = 2y$, and $p = \bar{p}$, with the latter mode clearly dominating the former one. Thus, when it is possible to grant one party more without own sacrifice, decision makers are guided by efficiency concerns to a greater extent than by equality concerns (Güth et al., 2009, 2012; Bäker et al., 2010).

4.3. Make it three or more players

There are several relevant ways to add players to the standard two-player ultimatum game. In proposer competition, at least two X players make an offer y to the single responder Y, who naturally will choose the largest offer, meaning that competition grants almost the entire pie $p(> 0)$ to the responder (see Roth et al., 1991). In responder competition at least two Y players set their acceptance threshold determining whether or not they accept the offer y of the only X player, where in case of more than one acceptance the Y player with the lowest threshold is selected (see Güth et al., 1998).²¹

In such games, there is no allocation that yields the same earnings to all players. Note that in proposer, respectively responder competition at least one X, respectively Y player is left empty-handed. Such inherent asymmetry apparently reduces the implicit demand of equal earnings for those actively striking a deal (in proposer, respectively responder competition, the only responder, respectively proposer receives considerably more than $p/2$). In a world in which unequal payoffs are unavoidable, the otherwise strong equality concerns seem to be much weaker.

The latter finding is also revealed by the results of three-person generosity and envy games with exogenously given agreement payoffs x, z of the proposer X and the additional dummy player Z, respectively y, z of responder Y and dummy player Z with $0 < x + z < p < \bar{p}$, respectively $0 < y + z < p < \bar{p}$. If \bar{p} is large enough, i.e., $\bar{p} > 3(x + y)/2$ respectively $\bar{p} > 3(x + z)/2$ (see Güth et al., 2010, as well as Bäker et al., 2010), and if $x \neq z$, respectively $y \neq z$, the modal choice is $p = \bar{p}$. Thus, in case

²⁰ Folk theorems for infinitely repeated base games with a unique equilibrium (for example, prisoners' dilemma games) claim such a discontinuity (for finite horizons, there exists one subgame perfect equilibrium, whereas the set of such equilibria explodes when assuming an infinite horizon). Behaviorally, this discontinuity does not seem to exist (except for the so-called endgame effect; participants are cooperating even when the horizon is finite and commonly known; see Selten and Stöcker, 1986).

²¹ One can also have more than two players and allow to endogenously expelling one (see Fischer and Güth, 2012, where proposers can expel one of two responders). Bereby-Meyer and Niederle (2005) use a three-person ultimatum game with different rejection payoffs for the third person with results questioning aspects of existing fairness theories. Fischbacher et al. (2009) also study the effects of competition on behavior in bargaining.

of unavoidable inequality, the main concern becomes efficiency. However, when $x = z$, respectively $y = z$, the modal choice is equality, i.e., $p = 3x = 3z$, respectively $p = 3y = 3z$, i.e. if general equality is feasible, it is usually implemented.

Compared to proposer and responder competition, such three-person generosity games and envy games increase the number of players by increasing the variety of player types. In addition to proposer X and responder Y, there is a dummy player Z without any direct influence on the allocation of resources. Three-person ultimatum-like games were inspired by the experiment of Güth and van Damme (1998), who let X allocate a given pie $p(> 0)$ by choosing (x, y, z) with $x, y, z \geq 0$ and $x + y + z = p$. They not only elicited the responses $\delta(x, y, z) \in \{0, 1\}$ but also the responses $\delta(y) \in \{0, 1\}$ and $\delta(z) \in \{0, 1\}$ via treatments where responder Y is only incompletely informed about (x, y, z) , namely by learning only y , respectively z .²² A striking result was that neither proposer X nor responder Y seemed to care much about the dummy player (see Bolton and Ockenfels, 1998, who focus on this observation). In contrast, a later newspaper experiment revealed at least some concerns for the dummy player Z (Güth et al., 2007).

Other variations distinguish an “only proposer” X, an “ambivalent” Y, and an “only responder” Z, meaning that, for example, X demands x with $x \in [0, p]$ from a given positive pie p . In case of $\delta(x) = 0$ by Y the game ends with zero payoffs for all, whereas when $\delta(x) = 1$, player Y becomes the proposer for the residual pie $p - x(\geq 0)$. Thus, after $\delta(x) = 1$, player Y demands y from $p - x$, and Z reacts by choosing $\rho(x, y) \in \{0, 1\}$.²³ The payoff of such two-level ultimatum games are $\delta(x)x$ for X, $\delta(x)\rho(x, y)y$ for Y and $\delta(x)\rho(x, y)(p - x - y)$ for Z (Güth et al., 1996). The main novelty is the ambiguous player Y who, in relation to X, is a responder and, in relation to Z, a proposer. Such a setup allows comparing the acceptance behavior of Y with his or her own proposal making, similar to employing the strategy vector method (see, for example, the newspaper experiment of Güth et al., 2003).²⁴ Furthermore, what Y chooses in a two-level ultimatum game is strongly influenced by the example x of player X.²⁵

5. From the turn of the century until now

Even if we restrict the time horizon to only the 14 years from 2000 until 2013 (less than half of the time since the first publication of an ultimatum bargaining experiment), we end up with almost 250 scholarly articles in journals that are listed in the Social Science Citation Index using the term “ultimatum game” in the title. The number shows that the ultimatum game is still relevant, mostly as a workhorse in behavioral economics and psychology research. In the following we provide a subjectively selected review of the main topics addressed in these papers and the major results of the studies.

5.1. Fairness perceptions and emotions

Although the ultimatum game is asymmetric by nature, one can further increase or decrease asymmetry by introducing asymmetry in conflict payoffs, outside options to be chosen or waived before playing the game, and asymmetries in information and communication possibilities (Brandts and Solà, 2001; Güth et al., 2001; Falk et al., 2003; Schmitt, 2004; Wichardt et al., 2009; Conrads and Irlenbusch, 2013). Naturally, such asymmetries favor those who are advantaged and disfavor the players in the disadvantaged role. In Conrads and Irlenbusch (2013), the proposer could remain ignorant about the payoff of the responder. Indeed, the proposers benefit from such ignorance because responders accept almost every offer.

Norm and fairness perceptions trigger emotional arousal, when responders are confronted with an unfair offer. Grimm and Mengel (2011) used an ultimatum game to show that an exogenously imposed cooling-off period before deciding about acceptance or rejection has an effect on behavior. Such delay in decision making reduces the proportion of rejected unfair offers. However, Tang et al. (2009), who let the delay be determined endogenously by the responders, observe that a self-inflicted delay, i.e., exerting self-control over one's immediate emotions, is rarely chosen voluntarily. The opposite, decision making under time pressure in the ultimatum game, has been studied by Sutter et al. (2003), with rejection rates of responders becoming significantly higher under a tight than under a very weak time constraint. However, the effect vanishes with repetition. Cappelletti et al. (2011) showed that time pressure leads to an increase in offers, whereas inducing cognitive load on decision makers did not have a significant effect on behavior compared to behavior in the standard ultimatum game.

Other studies elicit fairness perceptions by additional independent tests or questionnaires (Carpenter, 2003; Van Dijk et al., 2004), partly by differentiating between different emotions and perceptions that are actually activated when playing the game (Nelissen et al., 2009, 2010; Srivastava et al., 2009; Van Dijke and De Cremer, 2011). Finally, the ultimatum game has been used to study fairness behavior after inducing incidental (i.e., unrelated) emotions before play (Harle and Sanfey, 2007; Bonini et al., 2011), after depleting the ego resources of the decision makers (Halali et al., 2013), and even after sleep deprivation (Anderson and Dickinson, 2010).

²² In their experiment they did not allow the dummy player Z to accept or reject only what is given to him (with the other two players learning the choice of Z). Hence, the setup rendered the dummy Z not only choiceless but also voiceless.

²³ One may inform Z only about y rather than about (x, y) so that $\rho(y) \in \{0, 1\}$, i.e., Z only learns what is offered to him or her.

²⁴ What early consistency tests (see the respective discussion in Güth, 1995) and the newspaper experiment reveal are different types of behavior: some participants would not accept their own offer, others accept nothing less than what they offer, and finally some offer more than what they minimally demand for themselves.

²⁵ Having groups decide in the role of proposers and responders, rather than individuals, has fueled team research in economics (Bornstein and Yaniv, 1998; Elbittar et al., 2011; a survey is provided by Kugler et al., 2012). For reasons of succinctness, we do not discuss those studies here.

5.2. Social comparison and information on previous play

Social comparison has been studied in a wide range of games and paradigms in economic experiments. By providing and varying population feedback (Bohnet and Zeckhauser, 2004) social comparison and its impact have been assessed in the context of the ultimatum game. Some studies add further players to the game (Alewell and Nicklisch, 2009) or introduce an uncertain pie size (Moran and Schweitzer, 2008); others go beyond interpersonal comparisons and focus on intrapersonal comparisons (Handgraaf et al., 2003) and even on intergenerational naïve advice and learning (Schotter and Sopher, 2007). The general finding of most papers in this area is that social comparison matters in the sense that it influences decision making in the ultimatum game significantly. Additionally, Schotter and Sopher (2007) provide evidence that advice, and also knowledge of the history of the play of the game by others, sharpen up expectations, leading to a tighter distribution of offers.

5.3. Socio-demographic and individual determinants of play

It is not surprising that economists are keen on documenting socio-economic determinants of decision making in standard experimental games. However, the issue of what are robust socio-economic determinants of behavior in these games is far from being settled. Results with regard to age, gender, income, and education effects are often inconclusive (recent contributions are, for instance, Saad and Gill, 2001; Eckel and Grossman, 2001; Solnick, 2001; Carpenter et al., 2005; Garcia-Gallego et al., 2012), especially if one takes a look at the overall picture over the last 30 years. Methodologically speaking, however, these results tend to become more and more reliable, with a steadily growing number of independent observations in single economic experiments, and especially with new methods such as newspaper experiments (Güth et al., 2003), incorporating experiments into large-scale or representative surveys (Bellemare et al., 2008, 2011; Exadaktylos et al., 2013), and internet experiments. Obviously, increasing numbers of observations within one consistent study are key for robustly assessing the impact of socio-demographics on economic behavior in the experimental laboratory.

Personal features of proposer and responder participants (such as names or other cues that modify social distance) also influence behavior in the ultimatum game in the predicted directions (Charness and Gneezy, 2008; Marchetti et al., 2011), and high-testosterone men reject low ultimatum offers more often (Burnham, 2007), as expected. Zak et al. (2009) administered testosterone and observe a significantly negative effect on offers. Emanuele et al. (2008) provided evidence for the relevance of serotonin: low platelet serotonin levels make people more likely to reject unfair ultimatum offers.

The issue of cultural influences on behavior in the ultimatum game has always been a hot research topic, but comparisons have been quite unsystematic, so far. Again large-scale studies with an international component could be helpful in answering open questions. Another way forward is conducting meta studies. Oosterbeek et al. (2004) provided results based on 37 papers with 75 results from ultimatum game experiments. However, potential differences in behavior cannot really be explained along the lines of well-known cultural classifications. Chen and Tang (2009) compared ultimatum bargaining behavior of Tibetans and ethnic Han Chinese and found that Tibetans are more likely to accept offers than their Han Chinese counterparts. Ferraro and Cummings (2007) ran ultimatum game experiments with Hispanics and Navajo subjects in the US and found differences in their behavior. Even though the percentage of equal split offers is remarkable among Spanish gypsies (above 90%) in a study by Brañas-Garza et al. (2006), responders were willing to accept low offers very often in their strategy vector ultimatum game. The usefulness of the ultimatum game as a tool for understanding the economic behavior of small-scale societies has been demonstrated by Henrich (2000) and Heinrich et al. (2001). It is used quite frequently in anthropology nowadays (e.g., Paciotti and Hadley, 2003; Bahry and Wilson, 2006).

Bargaining interactions among members of different cultures is another aspect that can readily be studied in the context of the ultimatum bargaining game. For instance, Chuah et al. (2007, 2009) let Malaysian Chinese and UK subjects meet opponents of their own as well as of the other culture in an ultimatum game. Similarly, Boarini et al. (2009) let Indian and French subjects interact in an ultimatum game.

5.4. Stakes and entitlements

While stake size effects on proposer and responder behavior are generally small (for a complete overview of the early literature, see Camerer, 2003), Andersen et al. (2011), show that rejections go down with an increasing stake size.

Introducing bargaining over another “currency”, i.e., over waiting time, reinforces previous results from standard ultimatum bargaining experiments (Berger et al., 2012), and creating stronger entitlements over the money by introducing a real-effort task shapes behavior in the predicted ways (Garcia-Gallego et al., 2008), as already mentioned in Section 3.

5.5. Variation of the choice format

Much of the discussion concerning “hot play” versus “cold play” – methodologically speaking, the difference between the direct response method and the strategy (vector) method in economic experiments (see also Brandts and Charness, 2011) – relied on evidence from the ultimatum game (Brosig et al., 2003; McLeish and Oxoby, 2004). The results are mixed, however, with a tendency of increasing rejection rates of unfair offers under the direct response method. Obviously, this is in line

with explanations that take emotions into account. Comparing deliberate play and random moves, Bolton et al. (2005) used specific versions of a mini-ultimatum game to study the impact of procedural fairness versus allocation fairness.

An interesting and still not fully understood regularity in experiments using the strategy vector method are non-monotone acceptance thresholds. Interestingly, the phenomenon that advantageous offers above the equal split are rejected is very robust (see also Section 3), although it is usually only a minority that exhibits such a behavior (Güth et al., 2003; Bahry and Wilson, 2006; Bellemare et al., 2008; Hennig-Schmidt et al., 2008). In order to be able to infer preferences from decisions in a more suitable way Andreoni et al. (2003) convexified the decisions in an ultimatum game. Their findings are in the ballpark of previous studies: Half of the subjects can be classified as money maximizers, half reveal a preference for fairness. Experimentally separating fairness concerns and failure to play the subgame perfect equilibrium – by comparing a tournament bargaining structure with control treatments in an ultimatum game setup – Andreoni and Blanchard (2006) found that fairness and imperfect learning are about equally important in shaping behavior.

Hoffman et al. (2000) used treatments that emphasize the interactive aspect of the game in the instructions for the proposers. Interestingly, there was a significant increase in proposals following the emphasis and not a decline as implied by the subgame perfect equilibrium of the game.

Selection of interaction partners as a treatment in the laboratory is rare. In the context of the ultimatum game, Holm and Engseid (2005) gave proposers the chance to select their bargaining partners based on income and gender. Low-income responders and female responders are much more popular than high-income participants and males.

Finally, Bühren et al. (2009) introduced a competitive framing in mini-ultimatum games utilizing chess puzzles, and they use chess players as their participants. While offers do not respond to the treatment variation (competitive versus neutral), accepting low offers is more prevalent in the competitive framing.

5.6. (Pre-play) communication and messages

Similar to the use of the ultimatum game as a workhorse for studying social comparison, the game has also been used extensively in order to explore varying forms of communication and their impact on behavior systematically. Both “cheap talk” (Xiao and Houser, 2005; Zultan, 2012) and potential deception over private information aspects in the game (Boles et al., 2000; Croson et al., 2003; Lusk and Hudson, 2004; Koning et al., 2011) have been analyzed. Examples for the first form are persuasion and non-binding requests (Rankin, 2003; Andersson et al., 2010).

Kriss et al. (2013) compared explicit deception (lies about the pie size) and implicit deception (through actions) in an ultimatum game with asymmetric information on the pie size. Deception is very common in their study, and it is more prevalent when only explicit deception is available than when information is communicated implicitly.

5.7. Brain imaging data, genetics, and evolution

To our knowledge, Sanfey et al. (2003) were the first in scanning brain activity while showing the participants fair and unfair offers in the ultimatum game. Unfair offers led to activity in brain areas related to both emotional responses (anterior insula) and cognition (dorsolateral prefrontal cortex). A heightened activity in the anterior insula for rejected unfair offers seems to reinforce questionnaire results that stress the important role of emotions in the ultimatum game.²⁶

Results from Wallace et al. (2007), based on a twin study, sparked the debate on the impact of nature and nurture on economic behavior. They find that more than 40% of the variation in subjects' rejection behavior in the ultimatum game can be explained by additive genetic effects. A somewhat similar general conclusion – i.e. that social preferences in the ultimatum game and related games are shaped by both prenatal and current biological factors – is provided in a study by Buser (2012), who uses digit ratios (2D:4D) and information on the menstrual cycle.²⁷

Rand et al. (2013) employ stochastic evolutionary game theory, where agents make mistakes when judging the payoffs and strategies of others, to show that natural selection favors fairness. An experiment provides empirical support for their theoretical findings.

6. What comes next?

Exploring take-it or leave-it offer bargaining with multi-dimensional proposals, as already attempted by the complex games in the original Güth et al. (1982) study, could be worthwhile when trying to disentangle how participants cognitively perceive such games and generate their decision behavior. Mostly, experimental researchers subscribe to the revealed preferences – more generally: motives – approach, meaning that they try to infer motives only from observed choice data. Doing so could be easier when the choice data are multi-dimensional.²⁸

²⁶ See also Boksem and De Cremer (2010).

²⁷ Further results on sex-hormone genes as well as a dopamine receptor gene and their association with bargaining in the ultimatum game are provided by Chew et al. (2013) and Zhong et al. (2010).

²⁸ The data of principal-agent experiments allowing the principal to propose a multi-dimensional contract or to discriminate between heterogeneous agents who can react by (non-)acceptance or by choosing high and low effort levels may be seen as a continuation of such attempts.

Social embedding of an ultimatum game matters. In the two-round alternating offer experiment of Güth and Tietz (1985, 1986), behavior in the second-period ultimatum (sub)game, reached after rejecting the first-round offer, was very different when this implied a 90%- (due to $p_2 = p_1/10$) or only a 10%-efficiency loss (due to $p_2 = 9p_1/10$). In the former case, participants were just trying to harm each other, whereas they behaved very similar as in standard (non-embedded) ultimatum experiments when the efficiency loss was minor. Similarly, the ultimatum game may be embedded socially, for example, by distinguishing an in-group and an out-group, varying the constellation of group origin. More specifically, both (proposers and responders) can come from the same group or both can come from different groups (see Zizzo, 2011, for a related study). Furthermore, being observed by an in-group or an out-group member while making a decision could be an interesting aspect for a study. These issues can also be investigated using other games, although norm-guidedness renders such attempts especially interesting in the context of the ultimatum game.

Ultimatum bargaining with incomplete information could experience a revival. Whereas so far, asymmetric information was mainly assumed by letting only the proposer know the pie size (see Mitzkewitz and Nagel, 1993; Rapoport et al., 1996), it is also conceivable that the responder is better informed (see Hoppe and Schmitz, 2013).²⁹ As in the theoretical analysis of Güth et al. (2004), one could, for instance, assume a sequential decision process in which, first, proposer X chooses x , i.e., what he or she demands for himself or herself, and then the pie size $p \in [p, \bar{p}]$ with $0 \leq p < \bar{p}$ is randomly chosen according to some positive density with carrier $[p, \bar{p}]$, before, finally, Y learns about both, X's demand x and the pie size p . In the end, Y decides between $\delta(x, p) = 0$ and $\delta(x, \bar{p}) = 1$, leading to payoffs $\delta(x, p)x$ for X and $\delta(x, p)(p - x)$ for Y.

When $x > \bar{p}$ is possible, one may be especially interested in case $x > p$, for example, with $p - x$ negative and p rather large: will responder Y accept the minor loss $p - x$ to give the large amount x to X? The results of generosity game and envy game experiments suggest such responder generosity, especially when x does not exceed half of the expected pie size. On the other hand, suffering a monetary loss for the other's sake seems unlikely. Choosing a take-it or leave-it offer not knowing yet how much is available and what the other, i.e., the responder, will accept should render ultimatum bargaining not only more realistic but also more exciting.

As indicated above, the ultimatum game is a special point, namely $(\alpha, \beta) = (0, 0)$, in the unit square of the more general class of α, β bargaining games with payoffs $\delta(x, y)x + \alpha[1 - \delta(x, y)]x$ for X and $\delta(x, y)y + \beta[1 - \delta(x, y)]y$ for Y. Exploring the entire class $(\alpha, \beta) \in [0, 1] \times [0, 1]$ systematically seems futile, although varying only α or only β for some (generic) value of the other parameter or of both like in Suleiman (1996) and Fellner and Güth (2003) can be interesting and might promote an awareness of how special the ultimatum game is. In experimental research, we rely often on special paradigms, for example symmetric games, rather than on generic ones which could approximate the degenerate paradigms when they are seen as particularly interesting.

There also are conceivable methodological innovations that could advance our knowledge of bargaining based on the ultimatum game. We have already mentioned the potential advantage of large-scale studies (e.g., Bellemare et al., 2008, 2011). An Internet experiment on the ultimatum game with thousands of participants would allow to address the impact of socio-demographic and socio-economic determinants of play in a very systematic way. We are also not aware of studies that link laboratory bargaining behavior with field bargaining behavior. In general, field experiments on bargaining are rare.

Finally, it is worth emphasizing the interdisciplinary path that the ultimatum game has taken. We have only superficially sampled the literature outside of economics and psychology. It is noteworthy that at least an equal share of the scholarly contributions that use the ultimatum game as a workhorse in the last 14 years comes from non-economics journals. Many different disciplines and sub-disciplines have adopted the game as a tool to study fairness in bargaining. Its simplicity as a game and its straightforward experimental implementation makes it useful for a very versatile deployment in experimental research.³⁰

7. Conclusion

In view of the already existing summary chapters in handbooks (for example, Roth, 1995) and textbooks on experimental economics (for example Camerer, 2003; Chaudhuri, 2009) and meta-analyses of ultimatum studies (for example, Cooper and Dutcher, 2011), the focus of this paper has been on the architecture of social interactions that can be captured by the ultimatum game and its modifications. We have also tried to provide a systematic (however, not comprehensive) overview of research based on the ultimatum game that has been conducted after the turn of the century.

The ultimatum game has probably undergone three partly overlapping phases in its development within the research community. It was first a tool to demonstrate that some assumptions in simple economic models were not adequate. After publishing the initial studies, researchers wanted to understand and “explain” the behavior of participants in ultimatum bargaining in a second phase. Toward the end of the phase, the data from the game inspired theoretical models of social preferences, and it was used to study the distribution of social preferences within a population. In the final phase, the

²⁹ The “acquiring-a-company” game of Bazerman and Samuelson (1983) is a game in this class. The “buyer” does not know the value of the firm when proposing a price that the “seller”, knowing the value of the firm, can accept or reject (see the related experiment of Dittrich et al., 2012).

³⁰ We have provided a list of examples that is by far not exhaustive (for instance we did not discuss the power-to-take game experiments; see Bosman and van Winden, 2002; Bosman et al., 2005; Ben-Shakhar et al., 2007; Sutter et al., 2009; Reuben and van Winden, 2010; or stronger deviations from the standard setup such as the ultimatum reciprocity measure in Nicklisch and Wolff, 2014). Many more extensions have been implemented.

ultimatum game became a standard workhorse in social science research, and it has been used in many different ways. It stands there together with other relevant workhorses from experimental economics such as the prisoners' dilemma game, the public goods game, the trust game, and the dictator game. Assessing the relative impact of these games on the development of behavioral and experimental economics would be an interesting study on its own. It seems that the usage of specific games in experimental economics somehow works in a cycle in which games become en vogue and go out of fashion after some time, and some eventually make a comeback.

At the time of implementation of the first ultimatum bargaining experiment, there was already a very active group of experimental researchers. Ultimatum bargaining has added to their existing research rather than starting from scratch. As being revealed by Güth (1976), ultimatum bargaining has already been in the air even before actually being experimentally explored. As far as we are concerned, having observed that human decision makers are not only and mainly interested in own material success was not a big surprise but something that had to be expected. What could not easily be anticipated is how socially, motivationally, and emotionally rich already the very simple ultimatum game turned out to be.

One major reason for the attractiveness of the ultimatum game is its simplicity. It is probably the game that can be explained most easily to a participant or somebody not familiar with economics at all. Second, the game is very easy to implement as an experiment. A third reason for the attractiveness of the game is probably provided by the straightforward extensions that are possible and that can go in many directions (see Sections 4 and 5 for examples). Whether it is the most suitable game to study or estimate social preferences and social preference models is a different question that cannot be answered without a detailed account and comparison with other experimental games. It is even conceivable that the enormous level of research on the ultimatum game for some time has distracted researchers away from other potentially interesting games or limited the creativity of researchers to invent new games and new forms of strategic interactions that are able to address general questions in the social sciences. These considerations lead to questions that probably historians of economic thought and economic methodology will answer in the future. However, without a counterfactual they will be hard to answer.

Apparently, the ultimatum game has been influential in economics, it has provided another bridge between economics and other social sciences, and it has influenced a lot of economists both theorists and experimentalists profoundly. In view of this, it has to be expected that the tradition of ultimatum bargaining research will continue in the future.

References

- Alewell, D., Nicklisch, A., 2009. Wage differentials and social comparison: an experimental study of interrelated ultimatum bargaining. *Int. Rev. Law Econ.* 29, 210–220.
- Andersen, S., Ertac, S., Gneezy, U., Hoffman, M., List, J.A., 2011. Stakes matter in ultimatum games. *Am. Econ. Rev.* 101, 3427–3439.
- Anderson, C., Dickinson, D.L., 2010. Bargaining and trust: the effects of 36 h sleep deprivation on socially interactive decisions. *J. Sleep Res.* 19, 54–63.
- Andersson, O., Galizzi, M., Kranz, S., Hoppe, T., van der Wiel, K., Wengström, E., 2010. Persuasion in experimental ultimatum games. *Econ. Lett.* 108, 16–18.
- Andreoni, J., Blanchard, E., 2006. Testing subgame perfection apart from fairness in ultimatum games. *Exp. Econ.* 9, 307–321.
- Andreoni, J., Castillo, M., Petrie, R., 2003. What do bargainers' preferences look like? Exploring a convex ultimatum game. *Am. Econ. Rev.* 93, 672–685.
- Armentier, O., 2006. Do wealth differences affect fairness considerations. *Int. Econ. Rev.* 47, 391–429.
- Aumann, R., 1974. Subjectivity and correlation in randomized strategies. *J. Math. Econ.* 1, 67–96.
- Avrami, J., Güth, W., Hertwig, R., Kareev, Y., Otsubo, H., 2010. Learning (not) to yield: an experimental study of evolving ultimatum game behavior. *Jena Economic Research Papers* 2010-092.
- Bahry, D.L., Wilson, R.K., 2006. Confusion or fairness in the field? Rejections in the ultimatum game under the strategy method. *J. Econ. Behav. Org.* 60, 37–54.
- Bäker, A., Güth, W., Pull, K., Stadler, M., Jena Economic Research Papers 2010-091 2010. Does entitlement crowd out efficiency or equality seeking? Selling the roles in generosity game experiments.
- Bazerman, M.H., Samuelson, W.F., 1983. I won the auction but don't want the prize. *J. Confl. Resolut.* 27, 618–634.
- Bellemare, C., Kröger, S., van Soest, A., 2008. Measuring inequity aversion in a heterogeneous population using experimental decisions and subjective probabilities. *Econometrica* 76, 815–839.
- Bellemare, C., Kröger, S., van Soest, A., 2011. Preferences, intentions, and expectations violations: a large-scale experiment with a representative subject pool. *J. Econ. Behav. Org.* 78, 349–365.
- Ben-Shakhar, G., Bornstein, G., Hopfensitz, A., van Winden, F., 2007. Reciprocity and emotions in bargaining using physiological and self-report measures. *J. Econ. Psychol.* 28, 314–323.
- Bereby-Meyer, Y., Niederle, M., 2005. Fairness in bargaining. *J. Econ. Behav. Org.* 56, 173–186.
- Berger, R., Rauhut, H., Prade, S., Helbing, D., 2012. Bargaining over waiting time in ultimatum game experiments. *Soc. Sci. Res.* 41, 372–379.
- Binmore, K., Shaked, A., Sutton, J., 1985. Testing noncooperative bargaining theory: a preliminary study. *Am. Econ. Rev.* 75, 1178–1180.
- Blanco, M., Engelmann, D., Normann, H.T., 2009. A within-subject analysis of other-regarding preferences. *Games Econ. Behav.* 72, 321–338.
- Boarini, R., Laslier, J.-F., Robin, S., 2009. Interpersonal comparisons of utility in bargaining: evidence from a transcontinental ultimatum game. *Theory Decis.* 67, 341–373.
- Bohnet, I., Zeckhauser, R., 2004. Social comparisons in ultimatum bargaining. *Scand. J. Econ.* 106, 495–510.
- Boksem, M.A.S., De Cremer, D., 2010. Fairness concerns predict medial frontal negativity amplitude in ultimatum bargaining. *Soc. Neurosci.* 5, 118–125.
- Boles, T., Croson, R., Murnighan, K., 2000. Deception and retribution in repeated ultimatum bargaining. *Org. Behav. Hum. Decis. Process.* 83, 235–259.
- Bolton, G.E., 1991. A comparative model of bargaining: theory and evidence. *Am. Econ. Rev.* 81, 1096–1136.
- Bolton, G.E., Brandts, J., Ockenfels, A., 2005. Fair procedures: evidence from games involving lotteries. *Econ. J.* 115, 1054–1076.
- Bolton, G.E., Ockenfels, A., 1998. Strategy and equity: an ERC-analysis of the Güth–van Damme game. *J. Math. Psychol.* 42, 215–226.
- Bolton, G.E., Ockenfels, A., 2000. ERC: a theory of equity, reciprocity and competition. *Am. Econ. Rev.* 90, 166–193.
- Bolton, G.E., Ockenfels, A., 2005. A stress test of fairness measures in models of social utility. *Econ. Theory* 25, 957–982.
- Bolton, G.E., Zwick, R., 1995. Anonymity versus punishment in ultimatum bargaining. *Games Econ. Behav.* 10, 95–121.
- Bonini, N., Hadjichristidis, C., Mazzocco, K., Demattè, M.L., Zampini, M., Sbarbati, A., Magon, S., 2011. Pecunia olet: the role of incidental disgust in the ultimatum game. *Emotion* 11, 965–969.
- Bornstein, G., Yaniv, I., 1998. Individual and group behavior in the ultimatum game: are groups more rational players? *Exp. Econ.* 1, 101–108.
- Bosman, R., van Winden, F., 2002. Emotional hazard in a power-to-take experiment. *Econ. J.* 112, 147–169.
- Bosman, R., Sutter, M., van Winden, F., 2005. The impact of real effort and emotions in the power-to-take game. *J. Econ. Psychol.* 26, 407–429.

- Brañas-Garza, P., Cobo-Reyes, R., Domínguez, A., 2006. "Si él lo necesita": Gypsy fairness in Vallecas. *Exp. Econ.* 9, 253–264.
- Brandts, J., Solà, C., 2001. Reference points and negative reciprocity in simple sequential games. *Games Econ. Behav.* 36, 138–157.
- Brandts, J., Charness, G., 2011. The strategy versus the direct-response method: a first survey of experimental comparisons. *Exp. Econ.* 14, 375–398.
- Brennan, G., Güth, W., Kliemt, H., 2008. Approximate truth in economic modeling. *Homo Oeconomicus* 25, 263–282.
- Brosig, J., Weimann, J., Yang, C.-L., 2003. The hot versus cold effect in a simple bargaining experiment. *Exp. Econ.* 6, 75–90.
- Bühren, C., Frank, B., Kramel, S., Werner, A., 2009. Decision-making in competitive framings – strategic behavior of chess players in mini-ultimatum game chess puzzles. *Econ. Lett.* 115, 356–358.
- Burnham, T.C., 2007. High testosterone men reject low ultimatum game offers. *Proc. R. Soc. London* 274, 2327–2330.
- Buser, T., 2012. Digit ratios, the menstrual cycle and social preferences. *Games Econ. Behav.* 76, 457–470.
- Camerer, C., 2003. *Behavioral Game Theory: Experiments in Strategic Interaction*. Princeton University Press, Princeton, NJ.
- Cappelletti, D., Güth, W., Ploner, M., 2011. Being of two minds: ultimatum offers under cognitive constraint. *J. Econ. Psychol.* 32, 940–950.
- Carpenter, J.P., 2003. Is fairness used instrumentally? Evidence from sequential bargaining. *J. Econ. Psychol.* 24, 467–489.
- Carpenter, J.P., Burks, S., Verhoogen, E., 2005. Comparing students to workers: the effects of social framing on behavior in distribution games. In: Carpenter, J.P., Harrison, G., List, J. (Eds.), *Research in Experimental Economics*, vol. 10. JAI/Elsevier, Amsterdam, Boston.
- Chaudhuri, A., 2009. *Experiments in Economics*. Routledge, New York.
- Charness, G., Gneezy, U., 2008. What's in a name? Anonymity and social distance in dictator and ultimatum games. *J. Econ. Behav. Org.* 68, 29–35.
- Charness, G., Rabin, M., 2002. Understanding social preferences with simple tests. *Q. J. Econ.* 117, 817–869.
- Chen, K., Tang, F., 2009. Cultural differences between Tibetans and ethnic Han Chinese in ultimatum bargaining experiments. *Eur. J. Polit. Econ.* 25, 78–84.
- Cherry, T.L., Frykblom, P., Shogren, J., 2002. Hardnose the dictator. *Am. Econ. Rev.* 92, 1218–1221.
- Chew, S.H., Epstein, R.P., Zhong, S., 2013. Sex-hormone genes and gender difference in ultimatum game: experimental evidence from China and Israel. *J. Econ. Behav. Org.* 90, 28–42.
- Chuah, S., Hoffmann, R., Jones, M., Williams, G., 2007. Do cultures clash? Evidence from cross-national ultimatum game experiments. *J. Econ. Behav. Org.* 64, 35–48.
- Chuah, S., Hoffmann, R., Jones, M., Williams, G., 2009. An economic anatomy of culture attitudes and behavior in inter- and intra-national ultimatum game experiments. *J. Econ. Psychol.* 30, 732–744.
- Conrads, J., Irlenbusch, B., 2013. Strategic ignorance in ultimatum bargaining. *J. Econ. Behav. Org.* 92, 104–115.
- Cooper, D., Dutcher, G., 2011. The dynamics of responder behavior in ultimatum games: a meta-study. *Exp. Econ.* 14, 519–546.
- Cooper, D., Feltovich, N., Roth, A., Zwick, R., 2003. Relative versus absolute speed of adjustment in strategic environments: responder behavior in ultimatum games. *Exp. Econ.* 6, 181–207.
- Cox, J.C., Friedman, D., Gjerstad, S., 2007. A tractable model of reciprocity and fairness. *Games Econ. Behav.* 59, 17–45.
- Crosan, R., Boles, T., Murnighan, K., 2003. Cheap talk in experiments: lying and threats in ultimatum games. *J. Econ. Behav. Org.* 51, 143–159.
- Dickinson, D.L., 2000. Ultimatum decision-making: a test of reciprocal kindness. *Theory Decis.* 48, 151–177.
- Dittrich, D., Güth, W., Kocher, M.G., Papanastasiou, P., 2012. Loss aversion and learning to bid. *Economica* 79, 226–257.
- Eckel, C.C., Grossman, P.J., 2001. Chivalry and solidarity in ultimatum games. *Econ. Inq.* 39, 171–188.
- Elbittar, A., Gombert, A., Sour, L., 2011. Group decision-making and voting in ultimatum bargaining: an experimental study. *B.E. J. Econ. Anal. Policy* 11, 1–33.
- Emanuele, E., Brondino, N., Bertona, M., Re, S., Geroldi, D., 2008. Relationship between platelet serotonin content and rejections of unfair offers in the ultimatum game. *Neurosci. Lett.* 437, 158–161.
- Exadaktylos, F., Espin, A.M., Brañas-Garza, P., 2013. Experimental subjects are not different. *Nat. Sci. Rep.* 3, 1213.
- Falk, A., Fehr, E., Fischbacher, U., 2003. On the nature of fair behavior. *Econ. Inq.* 41, 20–26.
- Falk, A., Fischbacher, U., 2005. A theory of reciprocity. *Games Econ. Behav.* 54, 293–315.
- Fehr, E., Schmidt, K., 1999. A theory of fairness, competition, and cooperation. *Q. J. Econ.* 114, 817–868.
- Fellner, G., Güth, W., 2003. What limits escalation? Varying threat power in an ultimatum experiment. *Econ. Lett.* 80, 53–60.
- Ferraro, P.J., Cummings, R.G., 2007. Cultural diversity, discrimination, and economic outcomes: an experimental analysis. *Econ. Inq.* 45, 217–232.
- Fischbacher, U., Fong, C., Fehr, E., 2009. Fairness, errors and the power of competition. *J. Econ. Behav. Org.* 72, 527–545.
- Fischer, S., Güth, W., 2012. Effects of exclusion on acceptance in ultimatum games. *J. Econ. Psychol.* 33, 1100–1114.
- Fischer, S., Güth, W., Müller, W., Stiehler, A., 2006. From ultimatum to Nash bargaining: theory and experimental evidence. *Exp. Econ.* 9, 17–33.
- Forsythe, R., Horowitz, J.L., Savin, N.E., Sefton, M., 1994. Fairness in simple bargaining experiments. *Games Econ. Behav.* 6, 347–369.
- Gächter, S., Riedl, A., 2005. Moral property rights in bargaining with infeasible claims. *Manage. Sci.* 51, 249–263.
- Gale, J., Binmore, K., Samuelson, L., 1995. Learning to be imperfect: the ultimatum game. *Games Econ. Behav.* 8, 56–90.
- García-Gallego, A., Georgantzis, N., Jaramillo-Gutiérrez, A., 2008. Ultimatum salary bargaining with real effort. *Econ. Lett.* 98, 78–83.
- García-Gallego, A., Georgantzis, N., Jaramillo-Gutiérrez, A., 2012. Gender differences in ultimatum games: despite rather than due to risk attitudes. *J. Econ. Behav. Org.* 83, 42–49.
- Gehrig, T., Güth, W., Levati, V., Levinský, R., Ockenfels, A., Uske, T., Weiland, T., 2007. Buying a pig in a poke: an experimental study of unconditional veto power. *J. Econ. Psychol.* 28, 692–703.
- Grimm, V., Mengel, F., 2011. Let me sleep on it: delay reduces rejection rates in ultimatum games. *Econ. Lett.* 111, 113–115.
- Güth, W., 1976. Towards a more general study of v. Stackelberg-situations. *Zeitschrift für die gesamte Staatswissenschaft* 132, 592–608.
- Güth, W., 1995. On ultimatum bargaining experiments – a personal review. *J. Econ. Behav. Org.* 27, 329–344.
- Güth, W., Huck, S., 1997. From ultimatum bargaining to dictatorship – an experimental study of four games varying in veto power. *Metroeconomica* 48, 262–279.
- Güth, W., Huck, S., Müller, S., 2001. The relevance of equal splits in ultimatum games. *Games Econ. Behav.* 37, 161–169.
- Güth, W., Huck, S., Ockenfels, P., 1996. Two-level ultimatum bargaining with incomplete information: an experimental study. *Econ. J.* 106, 593–604.
- Güth, W., Kirchkamp, O., 2012. Will you accept without knowing what? A Thuringian newspaper experiment of the yes-no game. *Exp. Econ.* 15, 656–666.
- Güth, W., Kovács, J., 2001. Why do people veto? An experimental analysis of the evaluation and the consequences of varying degrees of veto power. *Homo Oeconomicus* 18, 277–302.
- Güth, W., Levati, V., Ploner, M., Jena Economic Research Papers 2009–071 2009. Making the world a better place: Experimental evidence from the generosity game.
- Güth, W., Levati, V., Ploner, M., 2012. An experimental study of the generosity game. *Theory Decis.* 72, 51–63.
- Güth, W., Marchand, N., Rullière, J.L., 1998. Équilibre et dépendance du contexte: Une évaluation expérimentale du jeu de négociation sous ultimatum. *Revue Économique* 49, 785–794.
- Güth, W., Ockenfels, P., Wendel, M., 1993. Efficiency by trust in fairness? Multiperiod ultimatum bargaining experiments with an increasing cake. *Int. J. Game Theory* 22, 51–73.
- Güth, W., Pull, K., Stadler, M., Stribeck, A., 2010. Equity versus efficiency? Evidence from three-person generosity experiments. *Games* 1, 89–102.
- Güth, W., Ritzberger, K., van Damme, E., 2004. On the Nash bargaining solution with noise. *Eur. Econ. Rev.* 48, 697–713.
- Güth, W., Schmidt, C., Sutter, M., 2003. Fairness in the mail and opportunism in the Internet: a newspaper experiment on ultimatum bargaining. *Ger. Econ. Rev.* 4, 243–265.
- Güth, W., Schmidt, C., Sutter, M., 2007. Bargaining outside the lab – a newspaper experiment of a three-person ultimatum game. *Econ. J.* 117, 449–469.
- Güth, W., Schmittberger, R., Schwarze, B., 1982. An experimental analysis of ultimatum bargaining. *J. Econ. Behav. Org.* 3, 367–388.

- Güth, W., Schmittberger, R., Schwarze, B., 1983. A theoretical and experimental analysis of bidding behavior in Vickrey-auction games. *Zeitschrift für die gesamte Staatswissenschaft* 139, 269–288.
- Güth, W., Schwarze, B., 1983. Auctioning strategic roles to observe aspiration levels for conflict situations. In: Tietz, R. (Ed.), *Aspiration Levels in Bargaining and Economic Decisions*, Lecture Notes in Economics and Mathematical Systems. Springer, Berlin, pp. 217–230.
- Güth, W., Tietz, R., 1985. Strategic power versus distributive justice – an experimental analysis of ultimatum bargaining. In: Brandstätter, H., Kirchler, E. (Eds.), *Economic Psychology Proceedings of the 10th IAREP Annual Colloquium*. Linz, pp. 129–137.
- Güth, W., Tietz, R., 1986. Auctioning ultimatum bargaining positions – how to act if rational decisions are unacceptable? In: Scholz, R.W. (Ed.), *Current Issues in West German Decision Research*. P. Lang Publisher, Frankfurt, pp. 173–185.
- Güth, W., Tietz, R., 1990. Ultimatum bargaining behavior – a survey and comparison of experimental results. *J. Econ. Psychol.* 11, 417–449.
- Güth, W., van Damme, E., 1998. Information, strategic behavior and fairness in ultimatum bargaining – an experimental study. *J. Math. Psychol.* 42, 227–247.
- Halali, E., Bereby-Meyer, Y., Ockenfels, A., 2013. Is it all about the self? The effect of self-control depletion on ultimatum game proposers. *Front. Hum. Neurosci.* 7, 240.
- Handgraaf, M.J.J., Dijk, E., van Vermunt, R., Wilke, H.A.M., 2003. The salience of a recipient's alternatives: inter- and intrapersonal comparison in ultimatum games. *Organ. Behav. Hum. Decis. Process.* 90, 165–177.
- Harle, K., Sanfey, A.G., 2007. Incidental sadness biases social economic decisions in the ultimatum game. *Emotion* 7, 876–881.
- Harsanyi, J.C., 1959. A bargaining model for cooperative n-person games. In: Tucker, A.W., Luce, R.D. (Eds.), *Contributions to the Theory of Games IV*. Princeton University Press, Princeton, NJ, pp. 325–355.
- Harsanyi, J.C., Selten, R., 1988. A General Theory of Equilibrium Selection in Games. MIT Press, Cambridge, MA.
- Heinrich, J., Fehr, E., Boyd, R., 2001. In search of homo economicus: behavioral experiments in 15 small-scale societies. *Am. Econ. Rev.* 91, 73–78.
- Henrich, J., 2000. Does culture matter in economic behavior? Ultimatum game bargaining among the Machiguenga of the Peruvian Amazon. *Am. Econ. Rev.* 90, 973–979.
- Hennig-Schmidt, H., Li, Z., Yang, C., 2008. Why people reject advantageous offers – non monotone strategies in ultimatum bargaining. *J. Econ. Behav. Org.* 65, 373–384.
- Hoffman, E., McCabe, K., Smith, V., 1996. On expectations and the monetary stakes in ultimatum games. *Int. J. Game Theory* 25, 289–302.
- Hoffman, E., McCabe, K., Smith, V., 2000. The impact of exchange context on the activation of equity in ultimatum games. *Exp. Econ.* 3, 5–9.
- Hoffman, E., Spitzer, M.L., 1985. Entitlements, rights and fairness: an experimental examination of subjects' concepts on distributive justice. *J. Legal Stud.* 14, 259–297.
- Hoffman, R., Tee, J.Y., 2006. Adolescent-adult interactions and culture in the ultimatum game. *J. Econ. Psychol.* 27, 98–116.
- Holm, H., Engsel, P., 2005. Choosing bargaining partners – an experimental study on the impact of information about income, status and gender. *Exp. Econ.* 8, 183–216.
- Homans, G., 1961. *Social Behavior: Its Elementary Forms*. Routledge and Kegan Paul, London.
- Hoppe, I.E., Schmitz, P.W., 2013. Contracting under incomplete information and social preferences: an experimental study. *Rev. Econ. Stud.* 80, 1516–1544.
- Horner, V., Carter, D.J., Suchak, M., de Waal, F.B.M., 2011. Spontaneous prosocial choice by chimpanzees. *Proc. Acad. Sci.* 108, 13847–13851.
- Jensen, K., Call, J., Tomasello, M., 2007. Chimpanzees are vengeful but not spiteful. *PNAS* 104, 13046–13050.
- Johnson, E.J., Camerer, C., Sen, S., Rymon, T., 2002. Detecting failures of backward induction: monitoring information search in sequential bargaining. *J. Econ. Theory* 104, 6–47.
- Kirchsteiger, Georg, 1994. The role of envy in ultimatum games. *J. Econ. Behav. Org.* 25, 373–389.
- Kocher, M.G., Sutter, M., 2007. Trust and trustworthiness across different age groups. *Games Econ. Behav.* 59, 364–382.
- Koning, L., Steinel, W., Van Beest, I., Van Dijk, E., 2011. Power and deception in ultimatum bargaining. *Organ. Behav. Hum. Decis. Process.* 115, 35–42.
- Krele, W., 1962. *Verteilungstheorie*. Springer, Cham.
- Kriss, P.H., Nagel, R., Weber, R.A., 2013. Implicit vs. explicit deception in ultimatum games with incomplete information. *J. Econ. Behav. Org.* 93, 337–346.
- Kugler, T., Kausel, E., Kocher, M.G., 2012. Are groups more rational than individuals? A review of interactive decision making in groups. *WIREs Cogn. Sci.* 3, 471–482.
- Levine, D., 1998. Modeling altruism and spitefulness in experiments. *Rev. Econ. Dyn.* 1, 593–662.
- Lin, H., Sunder, S., 2002. Using experimental data to model bargaining behavior in ultimatum games. In: Zwick, R., Rapoport, A. (Eds.), *Experimental Business Research*. Kluwer Academic Publishers, Boston, MA, pp. 373–397.
- Loewenstein, G., Bazerman, M.H., Thompson, L., 1989. Social utility and decision making in interpersonal contexts. *J. Pers. Soc. Psychol.* 57, 426–441.
- Lusk, J., Hudson, D., 2004. Effect of monitor-subject cheap talk on ultimatum game offers. *J. Econ. Behav. Org.* 54, 439–443.
- McLeish, K., Oxoby, R., 2004. Sequential decision and strategy vector methods in ultimatum bargaining: evidence on the strength of other-regarding behavior. *Econ. Lett.* 84, 399–405.
- Marchetti, A., Castelli, I., Harlé, K.M., Sanfey, A.G., 2011. Expectations and outcome: the role of proposer features in the ultimatum game. *J. Econ. Psychol.* 32, 446–449.
- Mikula, G., 1973. *Gewinnaufteilungsverhalten in Dyaden bei variiertem Leistungsverhältnis*. Zeitschrift für Sozialpsychologie 3, 126–133.
- Mitzkewitz, M., Nagel, R., 1993. Envy, greed and anticipation in ultimatum games with incomplete information. *Int. J. Game Theory* 22, 171–198.
- Moran, S., Schweitzer, M., 2008. When better is worse: envy and the use of deception in negotiations. *Negot. Confl. Manage. Res.* 1, 3–29.
- Murnighan, J.K., Saxon, M.S., 1998. Ultimatum bargaining by children and adults. *J. Econ. Psychol.* 19, 415–445.
- Myerson, R.B., 1978. Refinements of the Nash equilibrium concept. *Int. J. Game Theory* 15, 133–154.
- Nash, J.F., 1950. The bargaining problem. *Econometrica* 18, 155–162.
- Neelin, J., Sonnenschein, H., Spiegel, M., 1998. A further test of non-cooperative bargaining theory: comment. *Am. Econ. Rev.* 78, 824–836.
- Nelissen, R.M.A., van Someren, D.S.I., Zeelenberg, M., 2009. Take it or leave it for something better? Responses to fair offers in ultimatum bargaining. *J. Exp. Soc. Psychol.* 45, 1227–1231.
- Nelissen, R.M.A., Leliveld, M.C., van Dijk, E., Zeelenberg, M., 2010. Fear and guilt in proposers: using emotions to explain offers in ultimatum bargaining. *Eur. J. Soc. Psychol.* 41, 78–85.
- Nicklisch, A., Wolff, I., 2014. On the nature of reciprocity: evidence from the ultimatum reciprocity measure. *J. Econ. Behav. Org.* 84, 892–905.
- Nydegger, R.V., Owen, G., 1975. Two person bargaining: an experimental test of the Nash Axioms. *Int. J. Game Theory* 3, 239–249.
- Ochs, J., Roth, A.E., 1989. An experimental study of sequential bargaining. *Am. Econ. Rev.* 79, 355–384.
- Oosterbeek, H., Sloof, R., van de Kuilen, G., 2004. Cultural differences in ultimatum game experiments: evidence from a meta-analysis. *Exp. Econ.* 7, 171–188.
- Paciotti, B., Hadley, C., 2003. The ultimatum game in southwestern Tanzania: ethnic variation and institutional scope. *Curr. Anthropol.* 44, 427–432.
- Plott, C.R., Smith, V., 2008. *Handbook of Experimental Economics Results*, vol. 1. Amsterdam, North-Holland.
- Rabin, M., 1993. Incorporating fairness into game theory and economics. *Am. Econ. Rev.* 83, 1281–1302.
- Rand, D.G., Tarnita, C.E., Ohtsuki, H., Nowak, M.A., 2013. Evolution of fairness in the one-shot anonymous ultimatum game. *Proc. Natl. Acad. Sci.* 110, 2581–2586.
- Rankin, F.W., 2003. Communication in ultimatum games. *Econ. Lett.* 81, 267–271.
- Rapoport, A., Sundali, J.A., Seale, D.A., 1996. Ultimatums in two-person bargaining with one-sided uncertainty: demand games. *J. Econ. Behav. Org.* 30, 173–196.
- Reuben, E., van Winden, F., 2010. Negative reciprocity and the interaction of emotions and fairness norms. *J. Econ. Psychol.* 31, 908–922.
- Roth, A., 1995. Bargaining experiments. In: Kagel, J., Roth, A. (Eds.), *Handbook of Experimental Economics*. Princeton University Press, Princeton.
- Roth, A.E., Erev, I., 1995. Learning in extensive-form games: experimental data and simple dynamic models in the intermediate term. *Games Econ. Behav.* 8, 164–212.

- Roth, A., Prasnikar, V., Okuno-Fujiwara, M., Zamir, S., 1991. Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburg, and Tokyo: an experimental study. *Am. Econ. Rev.* 81, 1068–1095.
- Rubinstein, A., 1982. Perfect equilibrium in a bargaining model. *Econometrica* 50, 97–109.
- Rubinstein, A., 1985. A bargaining model with incomplete information about time preferences. *Econometrica* 53, 1151–1172.
- Saad, G., Gill, T., 2001. Sex differences in the ultimatum game: an evolutionary psychology perspective. *J. Bioecon.* 3, 171–193.
- Sanfey, A., Rilling, J., Aronson, J., Nystrom, L., Cohen, J., 2003. The neural basis of economic decision-making in the ultimatum game. *Science* 300, 1755–1758.
- Sauermann, H., 1972. Beiträge zur experimentellen Wirtschaftsforschung – Contributions to Experimental Economics, vol. 3. JCB Mohr, Tübingen.
- Schmitt, P., 2004. On perceptions of fairness: the role of valuations, outside options, and information in ultimatum bargaining games. *Exp. Econ.* 7, 49–73.
- Schotter, A., Sopher, B., 2007. Advice and behavior in intergenerational ultimatum games: an experimental approach. *Games Econ. Behav.* 58, 365–393.
- Schwarze, B., 1983. *Auszahlungsaufteilungsverhalten in Apex-Spielen und Versteigerung der Spielerrollen – Eine spieltheoretische und experimentelle Analyse*, Dissertation Köln 1982, Berlin.
- Selten, R., 1965. Spieltheoretische Behandlung eines Oligopolmodells mit Nachfrageträgheit. *Zeitschrift für die gesamte Staatswissenschaft* 121, 301–324, and 667–689.
- Selten, R., 1975. Reexamination of the perfectness concept for equilibrium points in extensive games. *Int. J. Game Theory* 4, 25–55.
- Selten, R., Stöcker, R., 1986. End behavior in sequences of finite prisoner's dilemma supergames. A learning theory approach. *J. Econ. Behav. Org.* 7, 47–70.
- Shapiro, E.G., 1975. Effects of future interaction in reward allocation in dyads: equity or equality. *J. Pers. Soc. Psychol.* 31, 873–880.
- Siegel, S., Fouraker, L.E., 1960. *Bargaining and Group Decision Making*. McGraw-Hill, New York.
- Solnick, S.J., 2001. Gender differences in the ultimatum game. *Econ. Inq.* 39, 189–200.
- Srivastava, J., Espinoza, F., Fedorikhin, A., 2009. Coupling and decoupling of unfairness and anger in ultimatum bargaining. *J. Behav. Decis. Making* 22, 475–489.
- Ståhl, J., 1972. *Bargaining Theory*. The Economic Research Institute, Stockholm.
- Steinbeis, N., Bernhardt, B.C., Singer, T., 2012. Impulse control and underlying functions of the left DLPFC mediate age-related and age-independent individual differences in strategic social behavior. *Neuron* 73, 1040–1051.
- Suleiman, R., 1996. Expectations and fairness in a modified ultimatum game. *J. Econ. Psychol.* 17, 531–554.
- Sutter, M., 2006. Outcomes versus intentions. On the nature of fair behavior and its development with age. *J. Econ. Psychol.*, 69–78.
- Sutter, M., Bosman, R., Kocher, M.G., van Winden, F., 2009. Gender pairing and bargaining – beware the same sex! *Exp. Econ.* 12, 318–331.
- Sutter, M., Kocher, M.G., Strauß, S., 2003. Bargaining under time pressure in an experimental ultimatum game. *Econ. Lett.* 81, 341–347.
- Tang, W., Bearden, J.N., Tsetlin, I., 2009. Ultimatum deadlines. *Manage. Sci.* 55, 1423–1437.
- Van Dijke, M., De Cremer, D., 2011. When social accounts promote acceptance of unfair ultimatum offers: the role of the victim's stress responses to uncertainty and power position. *J. Econ. Psychol.* 32, 468–479.
- Van Dijk, E., De Cremer, D., Handgraaf, M.J.J., 2004. Social value orientations and the strategic use of fairness in ultimatum bargaining. *J. Exp. Soc. Psychol.* 40, 697–707.
- Wallace, B., Cesarini, D., Lichtenstein, P., Johannesson, M., 2007. Heritability of ultimatum game responder behavior. *Proc. Natl. Acad. Sci.* 104, 1531–1534.
- Wichardt, P., Schunk, D., Schmitz, P., 2009. Participation costs for responders can reduce rejection rates in ultimatum bargaining. *Econ. Lett.* 103, 33–35.
- Xiao, E., Houser, D., 2005. Emotion expression in human punishment behavior. *Proc. Natl. Acad. Sci.* 102, 7398–7401.
- Zak, P.J., Kurzban, R., Ahmadi, S., Swerdloff, R.S., Park, J., Efremidze, L., Redwine, K., Morgan, K., Matzner, W., 2009. Testosterone administration decreases generosity in the ultimatum game. *PLoS ONE* 4, e8330.
- Zeuthen, F., 1930. *Problems of Monopoly and Economics*. Routledge, London.
- Zhong, S., Israel, S., Shalev, I., Xue, H., Ebstein, R.P., Chew, S.H., 2010. Dopamine D4 receptor gene associated with fairness preference in ultimatum game. *PLoS ONE* 5, e13765.
- Zizzo, D.J., 2011. You are not in my boat: common fate and discrimination against outgroup members. *Int. Rev. Econ.* 58, 91–103.
- Zultan, R., 2012. Strategic and social pre-play communication in the ultimatum game. *J. Econ. Psychol.* 33, 425–434.