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Abstract In a duopoly market, aspiration levels express how much sellers want to earn given their expectations about the other's behavior. We augment the sellers' decision task by eliciting their profit aspiration. In a first experimental phase, whenever satisficing is not possible, sales choices, point beliefs, or aspiration levels have to be adapted. This allows us to investigate which of these three aspects individuals revise more often. In a second phase, testing the absorption of satisficing, participants are free to select non-satisficing sales profiles. The results reveal that most participants are satisficers who tend to adjust aspiration levels if they cannot be satisfied.

Keywords Satisficing behavior; Duopoly; Profit aspiration; Theory absorption

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1 Introduction

More than fifty years ago, Herbert A. Simon (1955) published a paper that became a basis for the theory of choice. Due to the informational and computational limits of human rationality, Simon suggested a theory of bounded rationality based on "satisficing". The basic idea of the satisficing approach is that people form aspiration levels on a goal variable (aspiration formation), search for alternatives that guarantee them (satisficing), and adapt their aspiration levels in the light of experience (aspiration adaptation). According to Simon, satisficing with its three constituent sub-processes conforms more to actual human behavior than descriptions built upon classical rationality (see also March, 1978).

Though the literature drawing on the notions of 'bounded rationality' and 'satisficing' in order to explain phenomena at odds with the classical concepts of perfect rationality is by now voluminous,[1] only recently experimental economists have started investigating satisficing behavior in the laboratory. Following the tradition of revealed preference analysis, some of these experiments try to detect aspiration levels and their adjustment by statistically analyzing search data (see, e.g., Zwick et al., 2003). Another branch of experimental work renders the satisficing approach applicable by directly eliciting aspiration levels (see Güth, 2007, and the references therein).

Our study differs from most former experiments in that it focuses on a setting with strategic interaction where satisficing depends on beliefs about the others' behavior. More specifically, we consider a multi-period duopoly market with various states of demand. In every period and for *every state*, each seller participant must choose a sales quantity, specify point beliefs about the opponent's sales quantity, and form a profit aspiration. We say that a seller follows a *satisficing* mode of behavior if the action profile she chooses

[1] In organization theory, for instance, there have been attempts to build theories of the business firm incorporating bounded rationality assumptions since the 70s (see, e.g., Leibenstein, 1976; Radner, 1975a,b). For a more recent study see Noreen and Burgstahler (1997).

is satisficing in the sense that, given her beliefs profile, the resulting expected profit in each state is not lower than the corresponding aspiration. To the best of our knowledge, the only previous experimental study analyzing how aspiration levels affect results in Cournot markets is that by Huck et al. (2007), who, however, do not directly elicit profit aspirations.

Within the duopoly market, we address two appealing (and hitherto neglected) questions concerning satisficing behavior. The first is whether individuals who do not comply with satisficing try out new choice alternatives, revise their beliefs about the opponent's behavior, or change their profit aspirations. The notion of "adjustment", or "adaptation", as it has been commonly used in theoretical models of boundedly rational behavior, allows agents to revise one of the elements of the decision problem at hand. For instance, in search theory, people adapt their aspiration levels from one period to the next (see, e.g., Radner, 1975b). In recent game theoretical models with satisficing players, aspiration levels are dynamically updated (Kim, 1999) or actions can be revised over time (Dixon, 2000; Napel, 2003). However, the issue of which aspect of their boundedly rational mental representation of the decision task individuals *actually* revise when their aspiration levels cannot be achieved has hardly ever been investigated.[2]

In our view, human beings not only contradict the ideal of perfect rationality, but they may also fail to be boundedly rational. Often one relies on routines that, although adapted to the environment in which they were generated, are no longer appropriate. According to Arthur (1994), humans use inductive reasoning: they "learn" which internal models or hypotheses work in specific contexts, and from time to time they may replace poorly performing hypotheses with new ones. Consequently, here, we do not presuppose that decision makers are born as satisficers. Rather, we assume that they can become

[2]Tietz et al. (1978) and Tietz (1997) have imposed structured aspiration ladders for negotiators and confirmed aspiration balancing (both parties concede equally often in aspiration steps) in bargaining experiments, without eliciting beliefs or asking for action profiles.

aware of the satisficing concept. If, after being acquainted with the concept, the decision makers still follow it, we say that satisficing is *absorbable*.[3]

The second question we address is related to the absorbability of satisficing when people interact strategically. In portfolio selection tasks with state-specific return aspirations, Güth et al. (2008a) find that participants are able to absorb the satisficing approach in a simple setting with two states of nature, whereas more complexity (i.e., the addition of a third state) renders the satisficing heuristics more difficult and its absorption less likely. In general, becoming aware of a theory can result from hiring a consultant, teaching, or learning. For instance, lecturing about a theory before the experiment may allow people to absorb that theory. Here, however, we try to experimentally induce absorption of satisficing by *familiarity* rather than by indoctrination.

To this aim as well as to explore our first research question (what individuals revise more often when their aspiration levels cannot be achieved), in a first experimental phase consisting of 12 periods, we force participants to revise any aspect of their decision process (own quantities, expected quantities, and/or profit aspirations) until their action profile is satisficing. To test then whether satisficing is absorbable, in a second phase consisting, for the sake of consistency, of 12 periods too, we still inform our seller participants of whether or not their action profile is satisficing, but allow them to freely choose their sales quantity.

Our concept of satisficing does not exclude unbounded rationality. Rather, it includes optimality as a border case. In particular, we shall refer to the behavior of a satisficing seller as being *optimal* if, for each state of demand, (i) the seller's chosen quantity is a best response to her point beliefs, and (ii) the seller's profit aspirations exhaust the full profit potential allowed by her sales choice and her point beliefs. Although it will depend on the complexity of the task whether and to what extent satisficing behavior diverges from optimal one, before investigating such dependency (e.g., by varying the complexity of

[3]The absorption problem goes back to Oskar Morgenstern, and has been recently discussed by Güth and Kliemt (2004).

the market model), we confine ourselves to test the adequacy of our *static* definition of satisficing behavior. Earlier studies (see the survey by Güth, 2007) have shown that there is a rather weak confirmation of the satisficing hypothesis when elicited aspiration levels are not incentivized. In the present study, we implement the payoff rule that participants earn their highest *actually* achieved aspiration. Since participants can be paid for their point beliefs too, we can presume that they predict the opponent's behavior as accurately as possible. If this is so, our payoff rule should strength the inclination to comply with optimality.

There are several follow-up studies in this line. One of them, Güth et al. (2008b), avoids multiple states of nature, but allows for multiple beliefs concerning the other sellers' behavior on a heterogeneous market with three sellers. Another, which is still work in progress, reduces the strategy sets and (instead of eliciting idiosyncratic beliefs) forces seller participants to form a profit aspiration for each strategy profile of the others. Thus, allowing only for point beliefs of the competing sellers (as we do in the present study) is just a first step of a broader research agenda trying to define and develop the satisficing approach more rigorously in the light of experimental findings that rely not only on choices but also on directly elicited aspiration data.

The paper proceeds as follows. Section 2 introduces the experimental duopoly market and the satisficing approach. Section 3 illustrates the experimental procedures in detail. Section 4 presents the experimental results, and Section 5 concludes.

2 The stochastic market and theoretical analysis

We study a homogeneous duopoly market with stochastic demand. Uncertainty of demand allows us to add variation to the game and to test how people behave across different demand conditions. To render the experimental scenario simple enough, we abstract from (production) costs so that revenues equal profits. The

stochastic aggregate inverse demand function is[4]

$$p_k = \max\{D_k - x_{k,a} - x_{k,b}, 0\}.$$

Here, p_k is the price as well as the unit profit in state k ($k = 1, \ldots, n$) of the homogeneous market when sellers a and b supply the amounts $x_{k,a}$ and $x_{k,b}$, respectively. D_k is a discrete stochastic variable with positive realizations obeying $D_k < D_{k+1}$ for $k < n$. For the sake of simplicity, we assume that all n realizations of the stochastic variable D_k are equally probable. When selling $x_{k,i}$ in state k, seller i ($i = a, b$) earns

$$\pi_{k,i}(x_{k,i}, x_{k,j}) = p_k x_{k,i} \qquad\qquad j = a, b; \quad j \neq i. \tag{1}$$

The Nash equilibrium for this market is straightforward to derive and is given by $x^*_{k,i} = D_k/3$, for $i = a, b$ and $k = 1, \ldots, n$, yielding the same state-dependent equilibrium profit of $\pi^*_{k,i} = (D_k/3)^2$ for both sellers.

The equilibrium benchmark assumes common knowledge of rationality. In our satisficing approach, we avoid such rationality requirement and suppose that every seller i forms idiosyncratic point beliefs about her competitor's sales quantity in each of the n states of demand. We further suppose that seller i forms a profit aspiration for each element of her beliefs profile. Let $\mathbf{b}_i = (b_{1,i}, \ldots, b_{n,i})$ be i's beliefs profile and let $\mathbf{A}_i = (A_{1,i}, \ldots, A_{n,i})$ denote i's aspiration profile, which complies with the monotonicity requirement $A_{k,i} \leq A_{k+1,i}$ for all $k < n$.[5] The action profile $\mathbf{x}_i = (x_{1,i}, \ldots, x_{n,i})$, with $x_{k,i} \leq x_{k+1,i}$ for all $k < n$, is *satisficing* if

$$\pi_{k,i}(x_{k,i}, b_{k,i}) \geq A_{k,i} \quad \text{for all} \quad k = 1, \ldots, n, \tag{2}$$

where $\pi_{k,i}(x_{k,i}, b_{k,i}) = (D_k - x_{k,i} - b_{k,i})x_{k,i}$ is the profit i can attain in state k given her chosen quantity $x_{k,i}$ and her beliefs about the competitor's quantity

[4]Every (piecewise) linear demand can be reduced to this form by an appropriate choice of the unit amount if the stochastic effect is a parallel shift of the demand curve. By imposing $p_k \geq 0$, we avoid specific rules for the case of losses during the experiment.

[5]Since we are interested in formalizing and testing experimentally the core concept of bounded rationality theory, evidence of non-monotonic aspiration profiles could provide no guidance on how to develop the theory. When n is large, bounded rationality may imply that one refrains from forming different profit aspirations for all states, i.e., seller i may state $A_{k,i} = A_{k+1,i}$ for some $k < n$.

$b_{k,i}$, i.e., $\pi_{k,i}(x_{k,i}, b_{k,i})$ represents i's expected profit in k. A state-dependent profit aspiration abiding by requirement (2) is called achievable aspiration. Note that (2) requires sellers to choose satisfactory actions in *all* n states of nature. This captures an important feature of Simon's theory: simultaneously doing more than one cognitively demanding task weakens human capabilities and induces real difficulties in handling even very simple choice problems (on this topic, see also Simon, 1979, and Lilly, 1994).

Since seller i's action profile is satisficing if her profit aspirations take on any value less than or equal to the maximum in (2), maximizing is a special case of satisficing.[6] In particular, we say that the behavior of satisficing seller i is *optimal* if (i) each component of her choice profile is a best response to the corresponding component of her beliefs profile, i.e., $x_{k,i} = \frac{D_k - b_{k,i}}{2}$ for all $k = 1, \ldots, n$, and (ii) her profit aspirations in each state coincide with the maximum expected profit attainable in that state, i.e., $A_{k,i} = \frac{(D_k - b_{k,i})^2}{4}$ for $k = 1, \ldots, n$. Sales choices that do not comply with condition (i) will be referred to as *type 1-deviation from optimality*; too moderate profit aspirations, not complying with condition (ii), will be referred to as *type 2-deviation from optimality.*

3 Experimental protocol

The computerized experiment was conducted at the laboratory of the Max Planck Institute in Jena (Germany). The experiment was programmed using the z-Tree software (Fischbacher, 2007). Overall, we ran four sessions with a total of 128 participants, all being students from various fields at the University of Jena.

Each experimental session consisted of two subsequent phases, with 12 periods each.[7] In each period, the 32 participants of a session were divided into

[6] See, e.g., van Witteloostuijn (1988) and Lilly (1994) for earlier studies demonstrating that maximizing and satisficing can lead to comparable results. An empirical test of how an optimizing search compares to a satisficing search has been conducted by Markovitch and Rosdeutscher (1992).

[7] The instructions distributed at the beginning explained the rules of the first experimental

16 groups á two sellers, so as to form 16 duopoly markets. New groups were randomly formed in each of the 24 repetitions (strangers design).[8] To collect more than one independent observation per session, subjects were rematched within matching groups of 8 players, guaranteeing 4 independent observations per session and 16 independent observations in total. In order to discourage repeated game effects, participants were not informed that random re-matching of the groups had been restricted in such a way.

In the instructions, subjects were told that they would act as a firm which, together with another firm, serves one market, and that in each period both were to choose, independently, how much to produce and sell. Quantities had to be integer numbers between 0 and 20. Participants were informed that their period-profit would be determined via function (1) and, therefore, would depend on the realized state of demand and on the total quantity chosen by the two firms for that state.

The variable D_k could assume three equally probable values: $D_1 = 12$, $D_2 = 24$, and $D_3 = 48$. Hence, the symmetric equilibrium requires each duopolist i to set $x^*_{1,i} = 4$, $x^*_{2,i} = 8$, and $x^*_{3,i} = 16$. The implied state-dependent equilibrium profits are $\pi^*_{1,i} = 16$, $\pi^*_{2,i} = 64$, $\pi^*_{3,i} = 256$. The unit of experimental money was the ECU with 1 ECU being equal to €0.01.

To familiarize participants with the satisficing concept and to investigate what is mostly revised in case of non-satisficing action profile, in the first phase (period 1–12), we forced subjects, via a so-called decision aid, to comply with satisficing requirement (2). In every period and each duopoly market, besides choosing her own sales profile $\mathbf{x}_i = (x_{1,i}, x_{2,i}, x_{3,i})$, each seller i had to predict her competitor's sales profile $\mathbf{b}_i = (b_{1,i}, b_{2,i}, b_{3,i})$ as well as form her own aspi-

phase only. Written instructions on the second phase were distributed at the end of the first one (a translation of the German instructions for the two phases can be found in the Appendix).

[8] This should avoid the possibility of tacit collusion. See Holt (1985) and Huck et al. (2001) for experimental studies showing collusion in partners design where the same subjects interact repeatedly.

rations profile $\mathbf{A}_i = (A_{1,i}, A_{2,i}, A_{3,i})$. Therefore, in every period, participants had to fulfil three tasks and provide a total of 9 decisions: (i) the quantity they wanted to produce and sell in each of the three states, (ii) the quantity they expected the other to produce and sell in each state, and (iii) the period-profit they aspired to in each state.

After having completed these tasks, it was checked by the software whether satisficing requirement (2) held. Each participant was then informed of whether or not her action profile was satisficing. If (2) was violated, the participant *had to* go back and revise one or more components of her decisions. Revisions were also allowed in case of compliance with (2), though. Only when (2) was fulfilled, the participant could confirm her specification and move to the next period.

To assess whether individuals *voluntarily* use the decision aid, as required by absorption of satisficing, in the second phase (period 13–24), we allowed participants to confirm their sales profile even though, owing to their elicited point beliefs, it was non-satisficing.

To incentivize expectations as well as aspiration choices we paid participants either according to their stated (point) beliefs or according to their profit aspirations, with both possibilities being equally likely. This method of paying should motivate participants both to predict the other's behavior as accurately as possible and to submit 'true' profit aspirations. When payments were based on stated beliefs, the payoff of seller participant i $(i = a, b)$ in selected state k $(k = 1, 2, 3)$ was given by:

$$W_{k,i} = 100 - |x_{k,j} - b_{k,i}| \qquad j = a, b; \qquad j \neq i.$$

We did not inform participants about the exact content of the above rule. We just explained them that the closer their predictions were to the actual quantity chosen by the other firm, the higher their earnings.[9]

[9] In light of Camerer and Hogarth's (1999) review, this should suffice to motivate subjects to report truthful beliefs, without overburdening them with a new payoff rule. As we did not disclose the rule, we did not deem necessary to modify the constant $C = 100$ depending on the state of nature.

When payments depended on profit aspirations, participant i earned her aspiration $A_{k,i}$ for the selected state k if the *actual* profit sufficed to satisfy $A_{k,i}$, i.e., if

$$\pi_{k,i}(x_{k,i}, x_{k,j}) \geq A_{k,i}. \tag{3}$$

If condition (3) was not met, seller i earned the highest aspiration $A_{l,i}$ such that $\pi_{k,i}(x_{k,i}, x_{k,j}) \geq A_{l,i}$.

Paying the highest achieved aspiration can be justified by the monotonicity of the states of demand, and somewhat mollifies the step-level procedure of paying the aspired profit only when it does not exceed the realized profit (see Güth et al., 2007). It also matches the implication of aspirations in the satisficing approach: one is satisfied if aspirations are met (realized profit is greater than aspired one), while one is unsatisfied if aspirations are not met (realized profit is smaller than aspired one). Due to the state-specificity of the various tasks, goal formation is not stochastic except for the possible uncertainty resulting from probabilistic beliefs concerning the other's choice.

At the end of each period, participants got individual feedback about both duopolists' sales profile $\mathbf{x}_a$ and $\mathbf{x}_b$, the selected state of nature, the implied profit, the dimension on which they were paid, and the resulting experimental earnings.

4 Experimental results

In reporting our results, we proceed as follows. First, we present an overview of elicited aspiration levels and sales behavior. Then, we turn to our main questions and investigate what is mostly revised by our participants (point beliefs, aspiration levels, or sales choices) whenever satisficing requirement (2) is not fulfilled, and whether people voluntarily maintain satisficing in phase 2 after having been 'obliged' to follow it in phase 1.

4.1 General results

Table 1 provides descriptive statistics on experimental earnings, sales choices, point beliefs and aspiration levels over all periods, separately for the first (periods 1–12) and the second phase (periods 13–24) of the experiment.

Table 1 about here

No significant difference is detected between experimental earnings in phase 1 and experimental earnings in phase 2 (two-sided Wilcoxon signed rank test, $p = 0.980$).[10] Sales choices in the worst state 1 and the intermediate state 2 do not significantly differ from the respective game-theoretical prediction, whatever phase we consider ($p > 0.05$ for both states in both phases, one-sided Wilcoxon signed rank tests of the null hypothesis that $x_{1,i} = 4$ and $x_{2,i} = 8$). In contrast, in the best state 3, participants tend to undersell as compared to the equilibrium benchmark ($p = 0.029$ in both phases). Thus, our seller participants are more collusive than predicted by equilibrium theory only when the market is rather strong. As regards beliefs about the competitor's sales amount, they are, in general, not accurate, but systematically below actual choices (in phase 1: $p < 0.002$ in all three states; in phase 2: $p < 0.04$ in all states; two-sided Wilcoxon signed rank test), suggesting that, overall, subjects' expectations are not rational.

Figure 1 relies on independent observations to draw boxplots of profit aspirations across periods, separately for each state. In phase 1 (cf., Figure 1a), profit aspirations exhibit an increasing and significant time trend for all the three states of demand (the Spearman correlation coefficients between *aspiration levels* and *periods 1–12* are 0.267, 0.322 and 0.408 for states 1, 2 and 3, respectively; $p < 0.001$ always).[11] As to phase 2 (cf., Figure 1b), profit aspirations for states 1 and 2 increase to a very small degree over the 12 periods

[10] Unless otherwise stated, all reported non-parametric tests are based on the 16 independent matching groups.

[11] For states 1 and 2, the aspiration trend stays rather constant after the fourth period (the Spearman coefficient between *aspiration levels* and *periods 5–12* equals 0.047 for state 1, and 0.001 for state 2; $p > 0.10$ in both cases).

($\rho = 0.151$ for state 1, and $\rho = 0.126$ for state 2; both $p < 0.05$), whereas profit aspirations for state 3 are rather stable ($\rho = 0.016$, $p = 0.409$). Furthermore, as suggested also by Table 1, for each state of demand, aspiration levels are significantly lower in phase 1 than in phase 2 ($p < 0.002$ for all three states; two-sided Wilcoxon test). Participants become "more demanding", in the sense of improving their aspired period-profit, in the second 12 periods.

Figure 1 about here

Looking at the spread of aspiration levels in phase 1, we find that the gap between profit aspirations in the best and the worst state increases significantly. Denoting by $\bar{A}_k$ the period-average aspirations in state k, with averages over players for each matching group, the Spearman coefficient between $\bar{A}_3 - \bar{A}_1$ and *periods 1–12* is 0.402 ($p < 0.001$). The same applies to the development of the spread between $\bar{A}_2$ and either $\bar{A}_3$ or $\bar{A}_1$ ($\rho_{\bar{A}_3-\bar{A}_2} = 0.384$, $\rho_{\bar{A}_2-\bar{A}_1} = 0.306$; $p < 0.001$ in both cases).[12] All considered spreads are stable in phase 2 ($\rho_{\bar{A}_3-\bar{A}_1} = 0.003$; $\rho_{\bar{A}_3-\bar{A}_2} = -0.034$; $\rho_{\bar{A}_2-\bar{A}_1} = 0.02$; $p > 0.05$).

4.2 Satisficing behavior

We now turn to our two main research questions. Subsection 4.2.1 presents an aggregate data analysis of satisficing behavior. Subsection 4.2.2 provides details about individual behavior.

4.2.1 Aggregate data

What do participants revise more often when satisficing requirement (2) does not hold? To answer this question, we separate the data according to phase because compliance with satisficing is mandatory in phase 1 and voluntary in phase 2. Figure 2 provides the number of changes in own sales choices, expected sales choices and aspiration levels within each single period of phase 1, separately for each state of demand. Figure 3 provides the same number for

[12] Over the last 8 periods, the increasing time trend in the spread between $\bar{A}_2$ and $\bar{A}_1$ vanishes ($\rho = 0.014$, $p = 0.870$).

phase 2.

Figures 2 and 3 about here

Starting from phase 1, out of all the 4608 individual observations (32 subjects $\times$ 3 states $\times$ 12 periods $\times$ 4 sessions), 3564 comply immediately with requirement (2) meaning that all three state-dependent profit aspirations are achievable at first attempt. Most of these immediately satisficing action profiles are confirmed, but a small number (134 or 3.76%) is revised, with most of the revisions (72%) concerning profit aspirations, some (16%) point beliefs, and just a few (11%) own sales choices. The observation that participants adapt mostly their aspiration levels when satisficing is not fulfilled also applies to the remaining 1044 observations, which are not immediately satisficing and, thus, must be revised. Among these observations, aspiration levels are changed more often (66%), followed by own actions and expected actions (both around 17%).[13] This finding is consistent with the results by Güth et al. (2008b), who report that non-immediately satisficing subjects tend to revise mainly their aspiration levels in a multi-period triopoly market where each seller participant must specify a set-valued prior-free conjecture about the others' behavior, and form a profit-aspiration for each element of her conjecture.

The finding that point beliefs are barely modified is, in retrospect, quite reasonable: if a subject expects the rival to choose a certain quantity, her beliefs should not vary unless new information comes in (which is not the case within a period). The further finding that aspiration levels are revised more often than own actions may be due to the fact that experimenting new sales quantities requires cognitive reconsideration of the market interaction whereas lowering the non-achievable profit aspirations involves no calculations. Boundedly rational individuals may therefore prefer a direct adaptation of their aspiration levels.[14]

[13] Considering only the last 8 periods does not qualitatively alter the ranking.

[14] Of course, this is a hindsight-driven, ad hoc explanation because, *a priori*, one could have expected seller participants to explore their action space more thoroughly whenever their profit aspirations were non-achievable.

Participants encounter particular difficulties in immediately complying with $\pi_{k,i}(x_{k,i}, b_{k,i}) \geq A_{k,i}$ when $k = 1$. In the worst state, the number of aspirations achievable at first attempt is 1311, which compares to 1340 (1441) immediately achievable aspirations in state 2 (3). This seems to indicate that the poorer the market, the lower the care or the cognitive effort exerted by the subjects.

Turning to the second phase, where choosing a satisficing action profile was voluntary, we find that out of the 1368 observations which were informed to be not satisficing, 150 decide to revise some aspects of their decision. As suggested by Figure 3, also in phase 2, aspirations are revised more often (62% of the times) than one's own and expected sales quantities, which are modified at a similar frequency (expected sales: 21%; own sales: 17%).

The latter observation indicates that some individuals are willing to adjust their own aspiration levels so as to render their action profile satisficing. This leads us to our second major research question: do participants deliberately maintain satisficing in the second phase? Figure 4 displays the proportion of finally satisficing participants in each period of phase 2, showing also the proportion of those who form an achievable aspiration in each state of demand.

Figure 4 about here

The proportion of participants who finally choose a satisficing action profile is above 60% in each period and is rather constant over time (the Spearman correlation coefficient between *satisficing action profiles* and *periods 1–12* is 0.164, $p = 0.604$). In their multi-period triopoly market where multiple states of demand are replaced with multiple beliefs about the other sellers' behavior, Güth et al. (2008b) find that more than 96% of participants are finally satisficing. Figure 4 shows that participants manage to form achievable aspirations more often in the best state 3 than in the other two states (overall, 91% in state 3 vs. 76% in states 1 and 2). Hence, also in phase 2, the higher the demand, the higher the effort subjects put into forming achievable aspirations.

According to satisficing requirement (2), a seller's aspired profit must be not greater than her expected profit in each state of demand. It is therefore instructive to investigate how the satisficing participants' aspiration levels compare to their expected profits. Figure 5 displays the time path of average aspirations and average expected profits, separately for each state and each phase. Phase 2's sample includes only satisficing choices.

Figure 5 about here

For each state of demand, whatever the phase, average achievable aspirations lie constantly below average expected profits. Overall, 93.6% of the satisficing participants specify at least one aspiration that is lower than the profit attainable given the chosen quantity and the expected quantity, and 70.3% of them specify profit aspirations lower than the attainable profit in all three states. Wilcoxon signed rank tests (two-sided) confirm that, in each phase and for each state, participants' elicited aspirations are significantly lower than their expected profits ($p < 0.001$ for all six comparisons). Thus, on average, satisficing subjects aspire to profits that are significantly smaller than those they might aim for, given their choice and their beliefs about the opponent's choice. While the gap between aspired and expected profit shrinks significantly over time for all three states in phase 1, it stays rather constant in phase 2.[15]

An explanation for this finding is that subjects are unable to make maximizing choices. Another explanation is that participants want to play "safe" and guarantee themselves a positive outcome in case of payment based on aspirations. If a seller participant does not think that her stated point beliefs are accurate (e.g., if her point beliefs are the mean of a second order distribution with positive variance), then reporting an aspiration lower than the expected profit may maximize expected earnings. However, in a setting where the "safe"

[15]Indicating by $\bar{E}(\hat{\pi}_k)$ the average expected profit in state k (with average over players per matching group), and recalling that $\bar{A}_k$ denotes the average aspirations in state k, in phase 1, Spearman ρs between $\bar{E}(\hat{\pi}_k)$ and $\bar{A}_k$ are -0.306, -0.474, and -0.489 for $k = 1$, 2, and 3, respectively ($p < 0.001$ always). The respective Spearman ρs in phase 2 are 0.027, -0.059, and -0.017 ($p > 0.40$ always).

play-argument loses relevance because seller participants could specify several beliefs and aspirations, Güth et al. (2008b) observe that 76.54% of the participants specify at least one aspiration that is lower than the profits attainable given the chosen price and the corresponding conjectured price. This suggests that 'asking for too little' may be a characteristic of boundedly rational individuals and is not triggered by our payment procedure.

To clarify the relationship of stated aspiration to maximization, we investigate whether satisficing subjects follow our two conditions for optimality. Table 2 presents, for each period of the two phases, (i) the percentage of subjects who choose at least one state-dependent quantity that is not a best response to the corresponding point beliefs (type 1-deviation from optimality), (ii) the percentage of subjects who best respond to their point beliefs in all states, but specify at least one too moderate aspiration (type 2-deviation from optimality), and (iii) the percentage of subjects who meet both conditions for optimality.[16]

Table 2 about here

Most seller participants fall within the type 1-deviation category in each of the 24 periods. Although the percentage of non-best responses tends to decrease over time, a two-sided Wilcoxon signed rank test does not reject the null hypothesis that the 16 average independent shares of type 1-deviation in the first and the last experimental period are the same ($p = 0.95$). The percentage of type 2-deviations done by those who best respond to their point beliefs ranges from 2.3% in period 1 of phase 1 to 5.5% in period 12 of phase 2. Yet, the difference between the two periods is not statistically significant (two-sided Wilcoxon signed rank test, $p = 0.36$). At the outset of the experiment, 3.9% of the participants meet the two conditions for optimality and this percentage is stable over time: a two-sided Wilcoxon signed rank comparing the frequency of optimal observations in the first and the last experimental period delivers $p =$

[16]The frequencies for phase 2 do not sum up to 100% because a few subjects did not comply with satisficing requirement (2).

0.73. Hence, our seller participants do not appear to comply with optimality: most of them fail to best respond to their beliefs about the opponent's behavior, and the slight decline in type 1-deviations does not lead to an increase in optimal choices because type 2-deviations become somewhat more frequent over time.

4.2.2 A closer look at the individual data

In phase 1, we classify individuals depending on how long they need to satisfice at first attempt and stick to their prompt satisficing afterwards. In particular, we distinguish subjects as follows.

1. *Never satisficers*: subjects who are requested to change some aspect of the choice problem in each single period.
2. *Later satisficers*: subjects who do not achieve and maintain immediate satisficing until period t, with $t \in \{9, 10, 11, 12\}$.
3. *Intermediate satisficers*: like the former category, but with $t \in \{5, 6, 7, 8\}$.
4. *Early satisficers*: subjects who are immediately satisficing either over all 12 periods or at least over the last 9 periods.

In phase 2, where compliance with requirement (2) was willful, we refer categories to whether subjects satisfice or not.

1. *Non-satisficers*: subjects who never comply with requirement (2).
2. *Weak satisficers*: subjects who do not start abiding by and maintaining (2) until period t, with $t \in \{9, 10, 11, 12\}$.
3. *Moderate satisficers*: like the former category, but with $t \in \{5, 6, 7, 8\}$.
4. *Strong satisficers*: subjects who satisfice either over all 12 periods or at least over the last 9 periods.

Table 3 about here

Table 3 reports the number of subjects who fall in each of the identified categories for each phase. Individual data confirm previous aggregate analysis.

In phase 1, most of our participants are early satisficers (more than 40%), and the proportion of those who satisfice *ab initio* and consecutively for at least the last 4 periods is also rather high (about 20%). Only a few subjects (less than 5%) never comply with satisficing immediately. Some participants do not fall in any of the identified categories: they immediately satisfice in some of the 12 periods of phase 1 in a random manner.

The individual data for phase 2 are also quite comforting for the satisficing approach: 48% subjects spontaneously satisfice for at least the last two-thirds of the phase (in particular, 37% behave satisfactorily over all 12 periods). Only 11% of the subjects (mainly, those "never satisficing" or "unclassifiable" in the first phase) never obey requirement (2). Moreover, 29 out of 53 early satisficers in phase 1 are strong satisficers in phase 2, and 18 out of the 24 intermediate satisficers in phase 1 are either strong or moderate satisficers in phase 2.

5 Conclusions

To experimentally test the satisficing approach in a strategic setting, we relied on a multi-period homogeneous duopoly market with three states of demand. In every period and for each state of demand, seller participants had to choose a sales quantity, predict the competitor's sales quantity, and form a profit aspiration. In this context, a seller participant is said to follow a satisficing mode of behavior if her profit aspirations do not exceed the profit realizable from the chosen and the expected quantity in *all* states of demand. To familiarize seller participants with satisficing and to investigate what they revise more often when the satisficing requirement is not fulfilled, in a first experimental phase, we forced them to choose satisficing action profiles. To test whether the satisficing concept is absorbable, in a second phase, we still imposed the satisficing routine, but allowed participants to freely choose their sales strategy.

Our major results are that, throughout the experiment, the overwhelming majority of seller participants adapt profit aspirations until they become achiev-

able, and voluntarily maintain satisficing in the second phase. The individual data analysis shows that more than 40% of the subjects can be classified as 'early satisficers' (they immediately satisfice at least over the last 9 periods of phase 1), and 48% are 'strong satisficers' (they spontaneously satisfice at least over the last 9 periods of phase 2). We observe rather few optimal choices: overall, 8.07% (10.34%) of our participants choose a quantity that best responds to their point beliefs, and only 3.3% (3.43%) meet both conditions for optimality in phase 1 (2).

A further important result of our study is that aspiration levels are, on average, below expected profit, meaning that satisficing participants forego some of the profit they could aspire to given their chosen quantity and their beliefs about the other's quantity. In the present setting, this may be due to "safe" play by the participants, who wanted to guarantee themselves a positive outcome in case of payment based on aspirations. However, Güth et al. (2008b) report the same finding in a triopoly experiment where the "safe" play-argument loses relevance, thereby suggesting that "being pleased with not too much" may be an intrinsic characteristic of boundedly rational individuals. As argued by, e.g., Heifetz and Minelli (2006), people may tend to form low aspiration levels so as to not regret their decisions ex-post.

To conclude, our primary goal here was to document relevant experimental evidence on our *static* definition of satisficing. There are several ways of extending our experimental design so as to account for the link between the environment faced by the players and their aspiration levels. Güth et al. (2008b) have altered the market structure by introducing heterogeneous products and more sellers. Other obvious extensions may concern the complexity of the duopoly market that may be varied by considering uncertainty in some parameters or asymmetry in cost and demand conditions.

Appendix. Instructions (originally in German)

Instructions for the first phase (period 1–12)

Welcome and thanks for participating in this experiment. Please read the following instructions carefully. From now on any communication with other participants is forbidden. If you have any questions, raise your hand. We will answer your questions individually. All participants receive identical instructions.

Throughout the experiment, you can earn money. How much you earn depends on your decisions, on the decisions of other participants matched with you, and on chance. The unit of experimental money will be the ECU (Experimental Currency Unit), where 1 ECU = €0.01. This means that 100 ECU = €1.

Detailed information on the experiment

In this experiment, you will have to make decisions repeatedly. In every period, you will be randomly matched into pairs. The participants forming a pair will randomly change after each period, so that the other member of your pair will be different from one period to the next. The identity of the other participants you will get in touch with will not be revealed to you at any time.

In the experiment, you have the role of a firm that, like one other firm (the participant you are matched with), produces and sells one and the same product on a market. In each period, you and the other firm in your pair have to decide, simultaneously and independently, what quantity you wish to produce. You as well as the other firm in your pair can choose to produce any integer amount between 0 and 20; i.e., your choice of quantity must be $0, 1, 2, \ldots, 19$, or 20. In the following, we shall refer to the quantity chosen by you as x_{you}, and to the quantity chosen by the other firm as x_{other}.

In each period, your profit depends on a random variable D, and on the quantities chosen by you and the other firm as follows:

$$\textit{Your period-profit} = [D - x_{\text{you}} - x_{\text{other}}] \times x_{\text{you}}.$$

In words, we subtract the quantities chosen by you and the other firm from the random variable D, and multiply the resulting amount by the quantity chosen by you. If the sum of the quantity chosen by you and the quantity chosen by the other firm is greater than D (i.e., if $x_{\text{you}} + x_{\text{other}} > D$), your period-profit will be zero so that you can never make losses.

The random variable D can take on one of three different values, depending on which of three scenarios occurs.

- If scenario 1 occurs, D will be equal to **12**.
- If scenario 2 occurs, D will be equal to **24**.
- If scenario 3 occurs, D will be equal to **48**.

The three scenarios are equally likely, meaning that $D = 12$ with $1/3$ probability, $D = 24$ with $1/3$ probability, and $D = 48$ with $1/3$ probability.

The decision aid

To help you decide how much to produce in each period, we provide you with a decision aid aiming at "satisfactory" decisions, i.e., decisions achieving your desired period-profit in each scenario. In particular, in each period, the decision aid will guide you through the following steps.

a. First, it will ask you to choose the quantity you wish to produce in each of the three scenarios. Specifically, you have to answer these three questions:

- How much do you want to produce in scenario 1?
- How much do you want to produce in scenario 2?
- How much do you want to produce in scenario 3?

For each scenario, you can choose any integer amount between 0 and 20. Furthermore, the amount you choose in scenario 3 must be not smaller than the amount you choose in scenario 2, which must be not smaller than the amount you choose in scenario 1. If you, for instance, decide to produce 10 in scenario 3, your production in scenario 2 can be at most 10 (i.e., 10 or less); if you opt for a production of 7 in scenario 2, then your production in scenario 1 can be at most 7 (i.e., 7 or less).

b. Then, the decision aid will ask you to predict the production decisions of the other firm. Specifically, you have to answer three further questions:

- How much do you expect the other firm to produce in scenario 1?
- How much do you expect the other firm to produce in scenario 2?
- How much do you expect the other firm to produce in scenario 3?

For each scenario, your expectation about the other firm's production must be an integer number between 0 and 20. Furthermore, your expectation for scenario 3 must be not smaller than your expectation for scenario 2, and the latter must be not smaller than your expectation for scenario 1. If you, for instance, expect the other firm to produce 13 in scenario 3, your expectation in scenario 2 can be at most 13; supposing

you expect from the other a production of 11 in scenario 2, then you expectation in scenario 1 cannot be higher than 11.

c. Finally, the decision aid will ask you to specify the period-profit you wish to guarantee yourself in each of the three scenarios. In particular, you will have to answer three more questions:

- Which period-profit would satisfy you in scenario 1?
- Which period-profit would satisfy you in scenario 2?
- Which period-profit would satisfy you in scenario 3?

In the following, we will refer to the period-profits you find satisficing as your *profit aspirations*. Your profit aspirations in scenario 3 must be not smaller than your profit aspirations in scenario 2, which must be not smaller than your profit aspirations in scenario 1.

d. After you have answered the 9 questions above, the decision aid will inform you whether your stated profit aspiration in each scenario can be achieved or not. That is, you will learn whether, given your own production choices and your expectations about the other firm's production, you can achieve your profit aspiration in each scenario.

e. If your stated profit aspiration *cannot* be achieved in some scenario, the decision aid will ask you to revise your own production choice, your expectation about the other firm's production, or your profit aspiration for that specific scenario. You can modify all three aspects above, two of them, or only one.

f. Only when you can achieve your stated profit aspiration in each scenario, you can move on to the next period.

The decision aid will assist you in every period, i.e., in each period you *must* go through all the steps mentioned above, and cannot move to the next period *until* the profit aspiration in each scenario can be achieved by your production choices and your expectations about the other's production.

Your experimental earnings in each period

Though your period-profit influences your experimental earnings, you are not paid according to your period-profit directly. Rather, your experimental earnings in each period will be determined as follows.

At the end of each period, the computer will randomly select one scenario and, thus, the value of D in that period. You can be paid either according to the difference between

your expectation and the quantity actually chosen by the other firm in the selected scenario, or according to your profit aspirations. These two possibilities are equally likely: with 50% probability your period-payment will be based on your expectation, and with 50% probability your period-payment will be based on your profit aspirations. If, by random choice, your payment is based on the difference between your expectation and the quantity actually chosen by the other, then the smaller this difference, the higher your payment. That is, the more accurate your expectation, the more you earn. If, by random choice, your payment is based on your aspirations, the computer checks whether, for the randomly selected scenario, your profit aspiration exceeds your period-profit in that scenario.

- If your profit aspiration in the randomly selected scenario does not exceed your period-profit, you earn an amount of ECU equal to your profit aspiration in the selected scenario.
- Otherwise, the computer will check whether your stated profit aspiration in another scenario does not exceed your period-profit in the selected scenario. You will, in this case, earn the highest profit aspiration not exceeding your period-profit in the selected scenario.
- If all your three profit aspirations exceed your period-profit in the selected scenario, your earnings in that period will be 0 (zero) ECU.

The information you receive at the end of each round

At the end of each period, you will be informed about (1) the actual production amounts chosen by the other firm in each of the three scenario; (2) the randomly selected scenario; (3) your period-profit in the selected scenario; (4) your period-experimental earnings as explained above.

Your final earnings

At the end of the experiment, your experimental earnings in each period will be added up. The resulting sum will be converted to euros and paid out.

Before the experiment starts, you will have to answer some control questions to ensure your understanding of the experiment, and the functioning of the decision aid.

Please remain quiet until the experiment starts and switch off your mobile phone. If you have any questions, please raise your hand now.

Instructions for the second phase (period 13–24)

The only change with respect to the first part is that now you are free to decide whether you want to make satisficing choices or not. That is, now, after having gone through the step-procedures of the decision aid, you can

- either confirm the three production choices (one per scenario), although they do not satisfy your profit aspirations
- or change any of them.

In the latter case, you will be informed of whether your final production choices allow you to achieve your profit aspirations or not.

Your experimental earnings in each period will be determined as in the first part.

The information you receive at the end of each period will also be the same as in the first part.

References

Arthur WB (1994) Inductive reasoning and bounded rationality, American Economic Review **84**, Papers and Proceedings of the Hundred and Sixth Annual Meeting of the American Economic Association: 406–411.

Camerer CF, Hogarth RM (1999) The effects of financial incentives in experiments: a review and capital-labor-production framework, Journal of Risk and Uncertainty **19**: 7–42.

Dixon HD (2000) Keeping up with the Joneses: competition and the evolution of collusion, Journal of Economic Behavior & Organization **43**: 223–238.

Fischbacher U (2007), Zurich toolbox for readymade economic experiments, Experimental Economics **10**: 171–178.

Güth W (2007) Satisficing in portfolio selection: theoretical aspects and experimental tests, Journal of Socio-Economics **36**: 505–522.

Güth W, Kliemt H (2004) Bounded rationality and theory absorption, Homo Oeconomicus **21**: 521–540.

Güth W, Levati MV, Ploner M (2007) Scenario-based satisficing in saving: a theoretical and experimental analysis, Jena Economic Research Papers in Economics No. 2007-049, Friedrich-Schiller-University Jena and Max Planck Institute of Economics.

Güth W, Levati MV, Ploner M (2008a) Is satisficing absorbable? An experimental study, Journal of Behavioral Finance **9**: 95–105.

Güth W, Levati MV, Ploner M (2008b) Satisficing and prior-free optimality in price competition: a theoretical and experimental analysis, Jena Economic Research Papers in Economics No. 2008-067, Friedrich-Schiller-University Jena and Max Planck Institute of Economics.

Heifetz A, Minelli E (2006) Aspiration traps, Working Papers ubs0610, Department of Economics, University of Brescia, Italy.

Holt C (1985) An experimental test of the consistent-conjectures hypothesis, American Economic Review **75**: 315–325.

Huck S, Konrad KA, Müller W, Normann HT (2007) The merger paradox and why aspiration levels let it fail in the laboratory, Economic Journal **117** (522): 1073–1095.

Huck S, Müller W, Normann HT (2001) Stackelberg beats Cournot: on collusion and efficiency in experimental markets, Economic Journal **111**: 749–765.

Kim Y (1999) Satisficing and optimality in 2 × 2 common interest games, Economic Theory **13**: 365–375.

Leibenstein H (1976) Beyond Economic Man, Harvard University Press, Cambridge (MA).

Lilly G (1994) Bounded rationality: a Simon-like explication, Journal of Economic Dynamics & Control **18**: 205–230.

March JG (1978) Bounded rationality, ambiguity, and the engineering of choice, The Bell Journal of Economics **9**(2), 587–608.

Markovitch S, Rosdeutscher I (1992) Systematic experimentation with deductive learning: satisficing vs. optimizing search, Proceedings of the Knowledge Compilation and Speedup Learning Workshop, Aberdeen, Scotland.

Napel S (2003) Aspiration adaptation in the ultimatum minigame, Games and Economic Behavior **43**: 86–106.

Noreen EW, Burgstahler D (1997) Full-cost pricing and the illusion of satisficing, Journal of Management Accounting Research **9**: 239–263.

Radner R (1975a) A behavioral model of cost reduction, Bell Journal of Economics **6**: 196–215.

Radner R (1975b) Satisficing, Journal of Mathematical Economics **2**: 253–262.

Simon HA (1955) A behavioral model of rational choice, Quarterly Journal of Economics **69**: 99–118.

Simon HA (1979) Rational decision-making in business organizations, American Economic Review **69**: 493–513.

Tietz R (1997) Adaptation of aspiration levels: theory and experiment, in Albers, W., Güth, W., Hammerstein, P., Moldovanu, B. and van Damme, E. (eds.), Understanding Strategic Interaction. Essays in Honor of Reinhard Selten, Springer, Berlin.

Tietz R, Weber HJ, Vidmajer U, Wentzel C (1978) On aspiration forming behavior in repetitive negotiations, in Sauermann, H. (ed.), Bargaining Behavior, Beiträge zur experimentellen Wirtschaftsforschung, **7**, Mohr Siebeck, Tübingen.

van Witteloostuijn A (1988) Maximising and satisficing: opposite or equivalent concepts?, Journal of Economic Psychology **9**: 289–313.

Zwick R, Rapoport A, Lo A, Muthukrishnan A (2003) Consumer search: not enough or too much?, Marketing Science **22**: 503–519.

Table 1 Descriptive statistics on experimental earnings, sales choices, point beliefs and aspiration levels, separately for phase 1 and phase 2

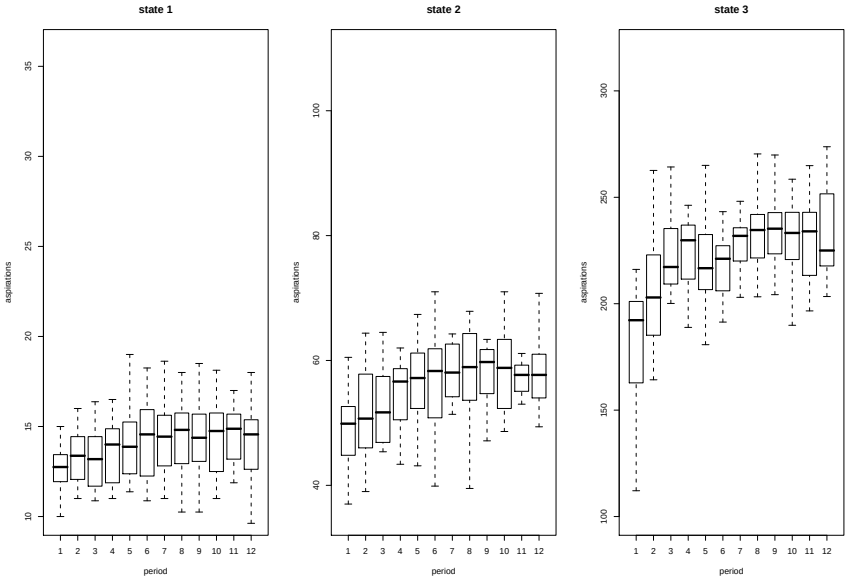
Phase	Variable	Mean	Median	Std. Dev.
1 (periods 1–12)	*Earnings*	9.87	9.63	0.95
	$x_{1,i}$	4.06	3.87	0.42
	$x_{2,i}$	8.29	8.14	0.68
	$x_{3,i}$	15.11	15.49	1.08
	$b_{1,i}$	3.67	3.68	0.28
	$b_{2,i}$	7.57	7.55	0.61
	$b_{3,i}$	14.08	14.21	1.14
	$A_{1,i}$	13.94	13.63	1.54
	$A_{2,i}$	55.37	55.77	5.39
	$A_{3,i}$	221.79	220.16	16.09
2 (periods 13–24)	*Earnings*	9.80	9.61	1.14
	$x_{1,i}$	4.25	4.10	0.68
	$x_{2,i}$	8.47	8.25	0.91
	$x_{3,i}$	15.74	15.86	1.15
	$b_{1,i}$	3.86	3.86	0.38
	$b_{2,i}$	7.84	7.93	0.83
	$b_{3,i}$	14.53	14.84	1.34
	$A_{1,i}$	21.38	20.51	5.77
	$A_{2,i}$	70.60	67.72	12.13
	$A_{3,i}$	239.87	239.80	28.82

Table 2 Deviations from and compliance with optimality

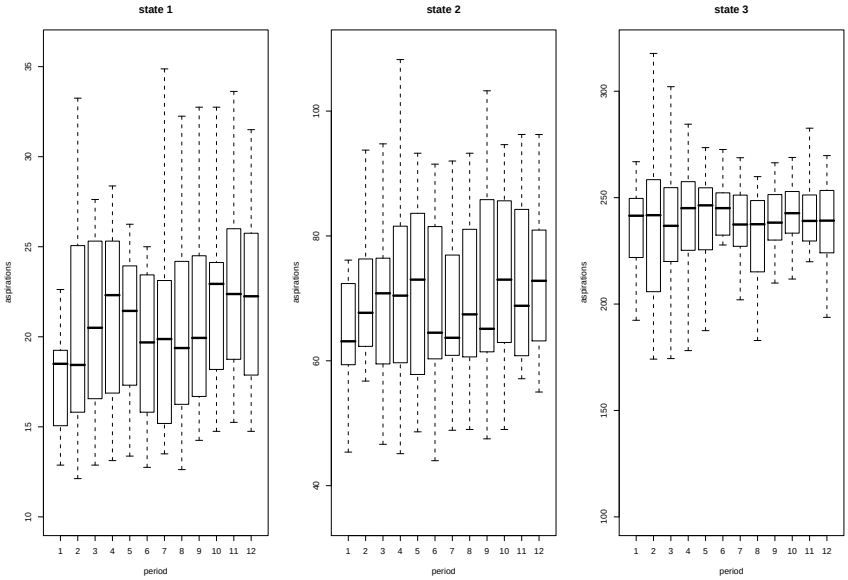
	Period											
	1	2	3	4	5	6	7	8	9	10	11	12
Phase	Type 1-deviation (% Subj)											
1	93.8	93.0	93.8	92.2	92.2	91.4	93.0	91.4	89.8	90.6	90.6	91.4
2	89.8	88.3	88.3	88.3	87.5	88.3	87.5	85.9	88.3	88.3	88.3	89.1
	Type 2-deviation (% Subj)											
1	2.3	3.1	3.9	5.5	5.5	5.5	3.9	5.5	7.0	5.5	4.7	4.7
2	5.5	6.3	7.0	5.5	7.0	7.0	7.0	8.6	8.6	8.6	6.3	5.5
	Optimality (% Subj)											
1	3.9	3.9	2.3	2.3	2.3	3.1	3.1	3.1	3.1	3.9	4.7	3.9
2	3.1	3.9	3.1	4.7	3.9	3.1	3.9	3.9	2.3	2.3	3.1	3.9

Table 3 Number of participants in accordance with each type

Phase 1		Phase 2	
Never satisficers	5	Non satisficers	14
Later satisficers	26	Weak satisficers	14
Intermediate satisficers	24	Moderate satisficers	13
Early satisficers	53	Strong satisficers	61
Unclassifiable	20	Unclassifiable	26



(a) Phase 1



(b) Phase 2

Figure 1: Aspiration levels across periods for each state of demand in both phases.

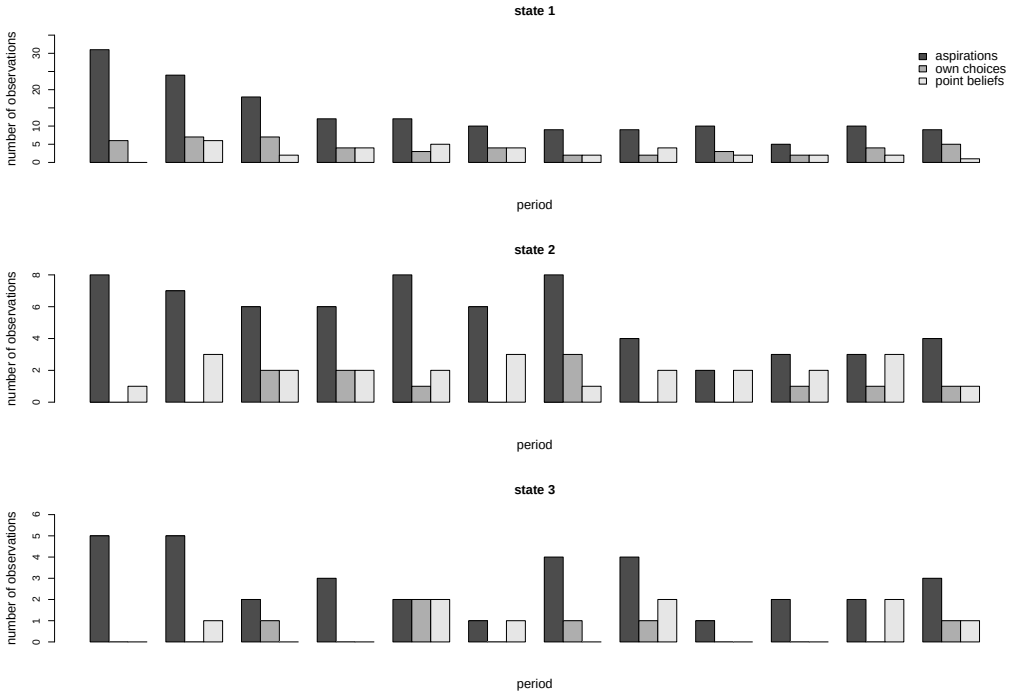


Figure 2: Number of changes in sales choices, point beliefs and profit aspirations over all 12 periods of phase 1, separately for each state of demand.

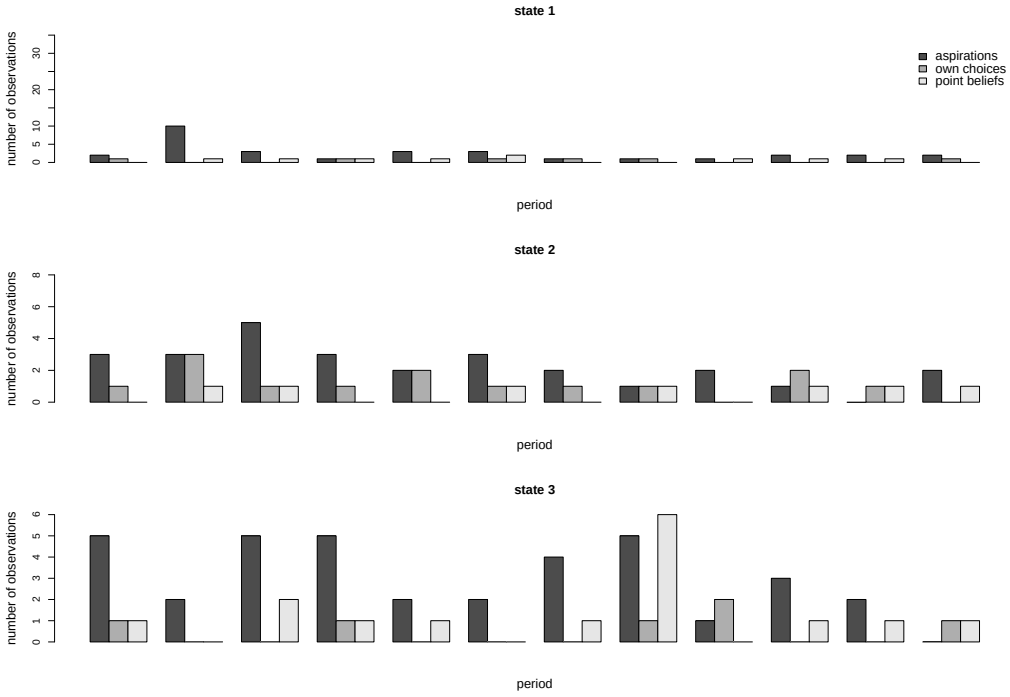


Figure 3: Number of changes in sales choices, point beliefs and profit aspirations over all 12 periods of phase 2, separately for each state of demand.

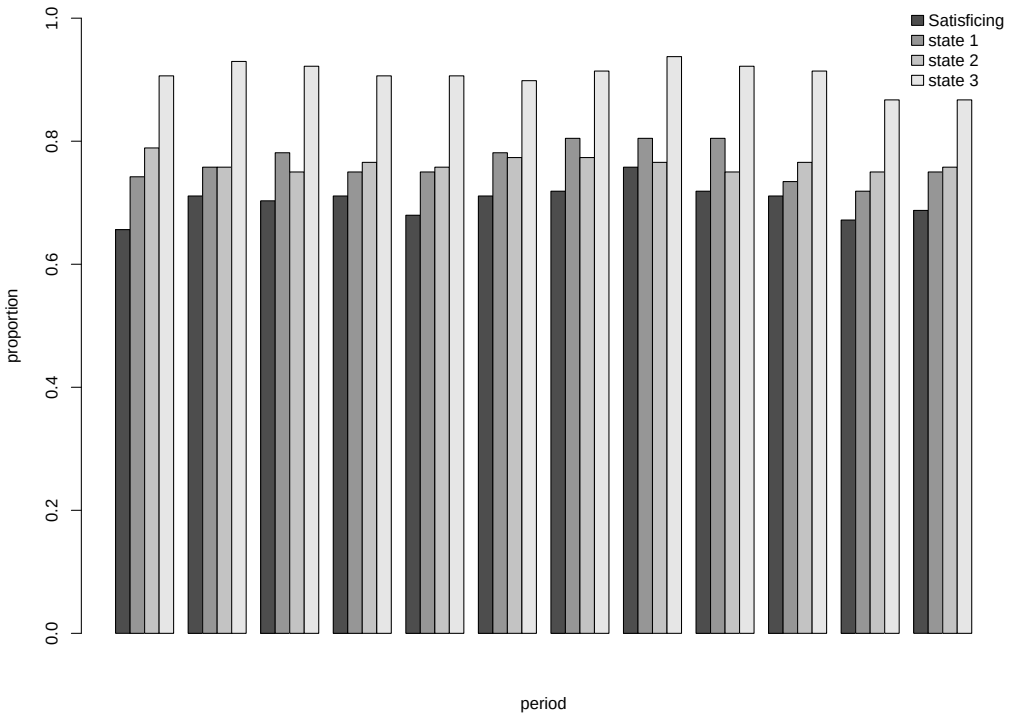
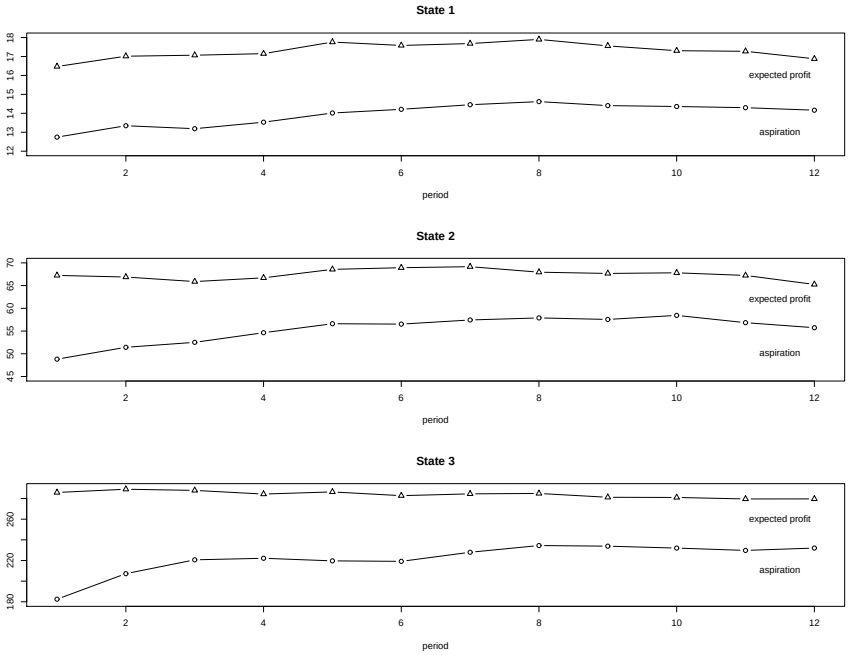
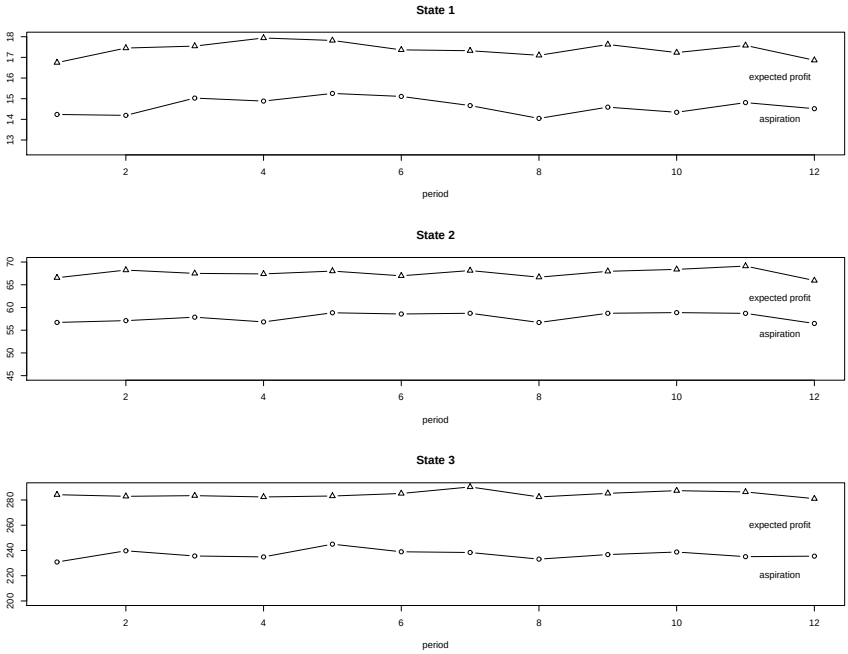


Figure 4: Frequencies of finally satisficing participants and of participants with an achievable profit aspiration in each state of demand.



(a) Phase 1



(b) Phase 2

Figure 5: Average aspirations and average expected profits in each state of demand, separately for phase 1 and phase 2.

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Satisficing in sales competition: experimental evidence

Abstract

In a duopoly market, aspiration levels express how much sellers want to earn given their expectations about the other's behavior. We augment the sellers' decision task by eliciting their profit aspiration. In a first experimental phase, whenever satisficing is not possible, sales choices, point beliefs, or aspiration levels have to be adapted. This allows us to investigate which of these three aspects individuals revise more often. In a second phase, testing the absorption of satisficing, participants are free to select non-satisficing sales profiles. The results reveal that most participants are satisficers who tend to adjust aspiration levels if they cannot be satisfied.

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