

The Competitor

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The European, and especially the German economy, are under severe pressure in many areas. A shortage of skilled workers, bureaucracy, and weak demand create an unfavorable situation that often leads to relocation or even restructuring.

The rise in construction interest rates is leading to reduced demand and reduced construction activity at times when a significant increase in activity would be necessary to meet the high demand for additional living space. Political concepts such as a rent freeze do not solve the fundamental problem of the supply shortage but rather exacerbate it.

Historical experience shows that ever-increasing state regulation restricts the scope for economic development, hinders technological progress, slows down productivity growth, reduces competitiveness and reduces prosperity.

In most cases, more market economy and less planned economy would do us good. We are in the middle of an intervention spiral in which problems that arise through state regulation are to be remedied through further intervention. The consequence is ever-increasing bureaucratization, which slows down or even stifles economic activity. It is not without reason that Germany and Europe have long been the world's growth laggards. According to most economists, this situation can only be overcome through massive deregulation and a return to the principles of the market economy. However, the more companies and people are dependent on and benefit from state regulation, subsidies and transfers, the more difficult it will be to achieve the political implementation of a release of market forces. The economist and Nobel Prize winner Friedrich August von Hayek predicted this development with astonishing precision 70 years ago.

Artificial intelligence (AI), one of the key technologies of the future, is a good example of undesirable developments: Europe is characteristically at the forefront in the regulation of AI, but not in the development of the technology itself. The question of what role Europe can still play in this area in the future is still open. However, the gap between Europe and its American competitors is enormous when you compare European solutions such as Aleph Alpha with OpenAI or BART.

Fortunately, however, there are always exceptions. The company Baselabs is one. It focuses on the development of software solutions for autonomous driving and links the input from various sensors, such as radar and cameras, in order to create the basis for better autonomous driving decisions.

In this issue's interview, Gero von Grawert talks to two founders of Baselabs, Robin Schubert and Eric Richter. The company develops software solutions for autonomous driving and sold its core IP last year. We were able to support BASELABS in the sale of its IP and contribute to a very positive result.

The second article in this issue deals with how Game Theory cooperation comes about. Game Theory can provide interesting insights into this: In a one-off interaction in the prisoner's dilemma, it is generally advantageous for both sides to cooperate, but individually each individual can always do better by not cooperating. Non-cooperation is therefore the expected solution in the one-off interaction.

With repeated interaction, however, cooperation can arise even within the unfavorable incentive structure of the prisoner's dilemma and can even be advantageous for all sides. Strategies that begin the interaction with cooperation, are not resentful, but are provokable, achieve the best results overall. Provokable in this context means that the strategy sanctions a lack of cooperation (i.e. the exploitation of one's own concessions by the other) in a certain way. The crucial question in theory and also in practice is how severely such behavior should be punished. This is particularly true if the likelihood of misunderstandings is taken into account. Immediate sanctioning can quickly lead to an unfavorable balance in which both sides repeatedly react to the previous sanctioning of the other side.

In any case, it can be said that it makes sense to focus on situations with repeated interaction. This increases the likelihood of finding solutions that benefit all parties and are therefore stable.

Christoph Pfeiffer

The Future of Mobility - Autonomous Driving

Gero von Grawert: Today we welcome Dr. Robin Schubert and Dr. Eric Richter, co-founders of Baselabs GmbH. Would you be so kind as to introduce yourselves briefly?

Robin Schubert: My name is Robin Schubert, I am married and have two children aged 16 and 11. Eric and I studied electrical engineering at Chemnitz University of Technology and conducted research in the field of automated driving with two other colleagues. This gave rise to the idea of developing software for recognizing the vehicle environment and offering it on the market. Around 2012, this was the starting signal for the company Baselabs GmbH, which the four of us founded. I have been Managing Director of the company since then.

Eric Richter: I'm Eric Richter, I'm married and have three children. Like Robin, I studied at Chemnitz University of Technology and did my doctorate and research in the field of electrical engineering. During this time, I worked intensively on the topic of automated driving. From a technical point of view, I have always been interested in making automated driving possible. At the same time, I was fascinated by the goal of implementing software and developing a product that people can operate and use. To this end, we four founders wanted to map our knowledge in software and make it available to developers. At the jointly founded company Baselabs, I drove product development, was active in sales and later switched to marketing.

Gero von Grawert: What exactly does Baselabs do?

Robin Schubert: Baselabs is concerned with making safe automated driving possible for all vehicles. The central topic of safety involves the tasks of reliably recognizing what is happening in a vehicle's surroundings, where other vehicles, pedestrians or cyclists are located, and drawing the necessary conclusions from this various information. This is why we have specialized in precisely this area, known as sensor data fusion. Here, data from various sensors in the vehicle's surroundings - such as cameras, radars or laser scanners - must be used and merged in order to make reliable decisions.

Gero von Grawert: Where does the name Baselabs come from?

Eric Richter: It goes back to the English mathematician and statistician Thomas Bayes, who lived in the 18th century. The methods we have developed are based on his mathematical findings and theories. However, we did not call the company Bayeslabs, but chose the more understandable spelling Baselabs.

Gero von Grawert: What are your most important products?

Robin Schubert: We currently have two technologies, Baselabs Create Embedded and Baselabs Dynamic Grid. The latter captures the world through a network of small squares, and the state of each of these squares must be determined, which can change continuously - hence the name Dynamic Grid.

Gero von Grawert: Very interesting - does artificial intelligence play a role here?

Eric Richter: Absolutely: on the one hand, the automatic parameterization of systems is about machine learning, on the other hand, the output of Baselab's Dynamic Grid complements existing AI-based processes. This output prevents, for example, the execution of a driving command generated by the AI if it would lead to a collision. AI solutions are, therefore, deliberately supplemented by a second safety net that is not based on AI.

Gero von Grawert: Are your solutions comparable to those of Tesla? Elon Musk's concept of autonomous driving, for example, does so without the use of radar because people can drive without radar.

Robin Schubert: That's right, which is why our solutions are not comparable with this concept. On the one hand, as Eric said, our solutions complement the AI architecture. Secondly, we have a different approach to the use of complex parallel sensor data: we use and measure different physical sources of information - visible light on the one hand, but also electromagnetic waves on the other. By comparing different sensor data, we can create a redundancy that provides additional safety. Tesla currently uses an assistance system that must be monitored by the driver at all times. Our customers are going much further here and developing systems that enable vehicles to actually drive autonomously - without the need for constant monitoring and possible intervention by the driver.

Gero von Grawert: What do you expect for the future of autonomous driving?

Eric Richter: We expect a combination of assistance and autonomous systems that have a different technological basis and are redundant. Specific solutions are currently being developed for very different applications: In the logistics sector, for example, systems are being built to automate traffic in logistics centers; special systems are being developed for agriculture, but also for mining vehicles in mining, for example. In the future, therefore, there will not be one universal system that can do everything in all environments. Still, rather specifically tailored systems will be developed and used for every application, from city traffic to underground parking garages and mining.

Robin Schubert: We can see from the current developments in California, for example, that the issue of safety is becoming increasingly important. Safety and trust are the decisive factors for the social acceptance of automated driving.

Gero von Grawert: How do Baselabs solutions contribute to this in principle?

Eric Richter: On the one hand, this is achieved through the redundancy explained above and, on the other, through the development of solutions for specific applications. Here, the tasks are usually technically more straightforward and the economic advantage is clearer: if, for example, a human driver is no longer needed in a logistics center, this saves costs on the one hand, and on the other, the autonomous vehicles can be permanently active. Of course, this is still very demanding and there are always residual risks. If, for example, no people are allowed in specially marked lanes in such a logistics center, it can still happen that someone accidentally stands there. This can never be completely ruled out, and this is precisely where one of Baselabs' technologies comes in.

The AI of an autonomous vehicle can never be trained for all theoretically possible cases, no matter how unlikely they may be. However, if an object in a very specific situation is unknown to the AI, it cannot recognize it and does not react or does not react correctly, even though the object is directly in front of one of the vehicle's cameras. The Baselabs technology enables unknown objects to be reliably recognized in such cases, thereby preventing collisions. In the case of the person in the logistics center, the vehicle then stops safely and informs the operator. The operator ensures that the person leaves the danger zone and the system can be released again. This solution would not be easy to implement on a highway, as stopping vehicles there would be dangerous and create further safety problems.

Gero von Grawert: Do automotive companies, OEMs, and major suppliers worldwide have a high strategic interest in these services from Baselabs?

Robin Schubert: Without a doubt! Companies worldwide are interested in these technologies because the technological challenges are similar. That's why Baselabs has traveled the world since it was founded, with customers in North

America, Asia, and Europe. Strategically, our solutions are particularly relevant for many customers because we offer our technology independently of specific sensors. It is, therefore, independent of all OEMs and suppliers. For this reason, none of these companies was or is one of our shareholders. Our process can be used with a wide variety of sensors.

Gero von Grawert: Do companies find it difficult to source this strategically important technology from outside? Wouldn't they prefer to have the expertise for this in-house instead of sourcing knowledge from outside and running the risk of their competitors having the same knowledge?

Eric Richter: This is a discussion we have had with actual and potential customers since day one. If they wanted to develop the technology themselves for strategic reasons, they might have advantages due to their size and would be independent. However, there would also be disadvantages: In-house development would take a lot of time and cost a lot. In addition, not every customer would be in a position to do this in terms of resources and knowledge.

Robin Schubert: When we founded the company, we thought this technology's strategic importance would diminish over time. This has indeed been the case with driver assistance systems - efforts to have the technology in-house have decreased and it has become more of a commodity over the years. However, the strategic relevance has increased in the area of highly or fully automated driving. In fact, more and more customers wanted to have the technology in-house and use it exclusively. This development was also one of the triggers for us to sell the company, as it did not fit in with our business model, which consisted of providing licenses for our technology to various customers. We felt this contradiction particularly strongly with our latest technology, which Eric described earlier. Customers want to own the technology, use it exclusively and thereby gain a competitive advantage: These goals are not compatible with our license model.

Gero von Grawert: You then decided to sell the company and your IP?

Robin Schubert: Exactly.

Gero von Grawert: What were the critical questions in this sale and how did you go about solving the task?

Eric Richter: The most important questions were initially: who is the ideal buyer(s) and what are our objectives? What do we want to achieve with the sale and how can we bring together the various interests of the stakeholders, i.e. the interests of the company's shareholders on the one hand and the employees on the other? After going through many different options, we finally decided on a relatively unusual way of selling, which in retrospect worked very well. This path consisted of selling the shares in the company and the software developed by the company separately. This has kept us busy over the past year.

Gero von Grawert: Interesting, how did you approach the sale of the software?

Robin Schubert: On the one hand, there were interested parties in our software who would have bought the company in order to gain access to our technology. However, it is highly unlikely that these interested parties would have been prepared to continue to employ all of our staff. On the other hand, there were interested parties who were primarily interested in the very good people and the team, but not in the software for strategic reasons. It took us some time to resolve this apparent dilemma. In the end, we sold the company shares to a company that was specifically interested in the people and kept all Baselabs employees on. At the same time, we were faced with the task of selling the company's software assets separately and as well as possible.

Gero von Grawert: How did you go about it?

Eric Richter: It was clear to us that we could only achieve a good result if there was competition and it was tangible for interested parties. At the beginning of the process, we analyzed the potential bidder field and took intensive

communication measures to activate and expand it: We implemented campaigns via email and LinkedIn, traveled to many events and activated all contacts and networks - all with the aim of informing potential buyers that they had the opportunity to acquire and own our technology for the first time. We used a structured process to identify the interested parties with the highest willingness to pay. Based on a non-disclosure agreement, this process, which was implemented with numerous interested parties, essentially consisted of a non-binding expression of interest, a binding offer and finally a parallel negotiation process in several stages.

Gero von Grawert: Were there any particular challenges here?

Robin Schubert: Yes, because we were faced with a difficult competitive situation with two types of interested parties: on the one hand, there were companies that wanted to purchase our software exclusively. On the other hand, there were a number of buyers who wanted to use the software on a non-exclusive basis. When a property is auctioned off, for example, there can only be one winner. In the case of our software, this would correspond to an exclusive buyer. But we also had several people interested in a non-exclusive license in addition to the exclusive ones. The difficulty in this particular situation was to create competition between these two groups on the one hand and, on the other, to get each individual interested party to pay as much as possible for the software. Another challenge was that the interested parties associated very different business models, strategies and use cases with this technology, which differed greatly from our previous business model. Therefore, it was not clear to us what the actual market price or value of our technology was. For each bidder, this value is of course highly dependent on their individual strategy and assessment of market opportunities. But even if we had a good idea of these different values and willingness to pay, how do we get the various interested parties to disclose them to us?

Eric Richter: Above all, we saw the danger that the - as we later called them - non-exclusive bidders would sit back and not move. They might assume that they will always receive a non-exclusive license because they think that the sum of all non-exclusive bids will always be greater than the highest exclusive bid. But if everyone thinks that way, nothing happens. So there were many different challenges. We were able to resolve some of them through good communication, for example by explaining why we were selling the company and the software separately and using the process we had started. As was shown by the great and serious interest, we succeeded quite well.

Gero von Grawert: And how did you decide on the specific form in which to implement your project?

Robin Schubert: As we had little experience with auction procedures or similar structured sales processes, we wanted to seek advice from specialists on how to set up such processes. Because you were recommended to us, we engaged you as a consulting firm in the field of game-theoretical negotiation optimization and developed the process that was later implemented together.

Gero von Grawert: We at Competitio found this collaboration extremely creative and good. How do you rate the result?

Robin Schubert: Personally, I'm really pleased with the result: On the one hand, we were able to mobilize a lot of interested parties. This was mainly due to the great work of our employees. Secondly, we managed to overcome the complex challenges relating to the value of our software for the various bidders and their willingness to pay. The key added value came from the fact that the developed process and the game-theoretically optimized negotiation design made it possible to intensify competition both between the two groups of exclusive and non-exclusive bidders and within the respective groups. The complex design of the developed auction process has led to a significant

improvement in the result, with which I am personally very happy and satisfied.

Gero von Grawert: We are very pleased about that. We find it remarkable that a company and its services were not sold as a whole, but that on the one hand the company and its employees were sold and on the other, separately and optimized in terms of game theory, the software developed by this company over the years. These two aspects can therefore be separated. In this case, this was done for the benefit of the employees - all of whom were taken over - and in the interests of achieving the highest possible selling price. Could this solution also be useful for other cases?

Robin Schubert: I think it worked well to sell our software separately because, as Eric said earlier, our mission from day one was to create software that users could use without us. For a typical startup with technology that is only developed to a certain level of maturity, it would certainly be much more difficult to sell and the benefits of separation might be less. But yes, I can imagine that such constellations occur more often.

Eric Richter: Another reason that led to this solution was the motivation of our customers to acquire a broad right to use our software. We wanted to make this possible by separating the company and the software. We wanted the software assets to be further developed and made available to many users.

Gero von Grawert: Dr. Schubert, Dr. Richter, thank you very much for the interview and we wish you and your employees all the best for the future!

The Emergence of Cooperation From the Perspective of Game Theory

The Prisoner's Dilemma

The prisoner's dilemma is the best-known example of applied game theory. This is due to its transferability to a variety of contexts and possibly also to its concise history. The prisoner's dilemma provides an answer to two central questions:

1. How can cooperation between players be prevented?
2. How can cooperation between players develop under adverse circumstances?

Both issues are relevant from a negotiation and purchasing perspective. An important goal in the development of award mechanisms is to prevent unwanted cooperation between suppliers. The prisoner's dilemma shows how a desired behavior of the players can be achieved by changing the structure of a game.

On the other hand, the question arises regarding the circumstances under which cooperation between suppliers can occur, even if there is a strong incentive not to cooperate. This question is primarily considered in the repeated prisoner's dilemma.

The Prisoner's Dilemma

Jim and Frank steal considerable money during a bank robbery, but are caught. They were able to get the money to safety before their arrest. At the police station, Jim and Frank are interrogated in separate cells. Both crooks can now either remain silent or confess. There is not yet enough evidence for a long prison sentence. They only have to reckon with a one-year prison sentence if both remain silent. As soon as one „sings“, however, both are sentenced to seven years in prison. In this game structure, it is better for both players to remain silent (see Figure 42left). Silence is a weakly dominant strategy under these circumstances, so the police officers' interrogation techniques lead to no result.

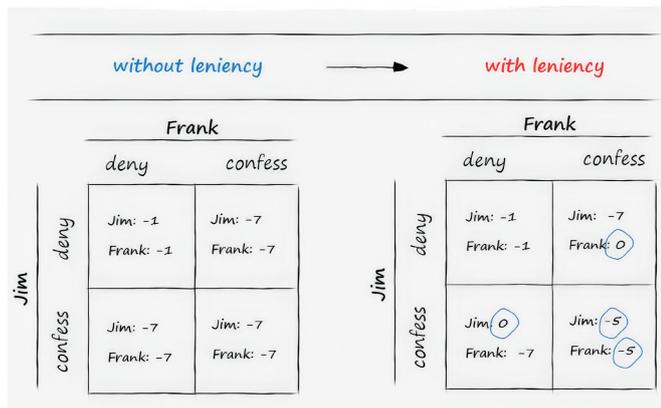


Figure 1: The leniency program is a mechanism that improves the payoff structure of the players so that the desired outcome (confession of both) is realized in expectation.

Introducing a leniency program changes the payoff structure of the two players so that confession becomes the dominant strategy.

However, the state has the power to set laws and can change the game's structure so that it is optimal for both players individually to confess. Through a leniency program, the player who confesses can expect to be released as long as the other player does not confess. In this case, the player who does not confess would go to prison for seven years. As long as both remain silent, the prison sentence remains at one year. If both confess, a sentence

of five years is to be expected, which means a slight reduction in the sentence compared to seven years. Confessing thus becomes the dominant alternative. The confession strategy always generates a better payoff than any other alternative, regardless of how the other player behaves. Under the changed framework conditions, it can be assumed that both players will confess. The prisoners' dilemma is that the best individual behavior does not lead to the best overall result. Collective silence would result in an overall lower prison sentence. In certain game structures, individually rational behavior does not lead to a collectively optimal result. Let's return to the questions formulated at the beginning.

In the context of organized crime, prison sentences are typically made more bearable (e.g., by paying a pension to the family during the prison term). In contrast, the threat of punishment makes confession less attractive.

Credibility is a prerequisite for incentives to have the intended effect. One problem with investigations is the inability of the police to make binding promises. Under the separation of powers, the decision on a prison sentence lies with a judge and is negotiated after a confession. A guaranteed pardon could further increase the effectiveness of leniency programs (see Miller, 2009).

It makes sense to look at the effect and purpose of statements intended to induce a certain behavior. These can be classified according to:

1. the consequences for the recipient (positive or negative),
2. the implementation costs for the broadcaster (available or free of charge),
3. their intention (motivating or deterring)
4. and their credibility (see Dixit and Nalebuff, 2008).

An announcement with a positive consequence for the recipient of the message, but with costs associated with its implementation is a promise. If the consequence is positive for the recipient of the message and free of charge

for the originator, it is a promise. An announcement with negative consequences for the recipient and an implementation associated with costs is a threat. Negative consequences with at least free implementation are a warning. A distinction can also be made between motivational and dissuasive statements.

Threats and promises are less credible because their implementation is associated with costs. The higher the implementation costs, the more difficult it is to achieve a high level of credibility for the statement. In negotiations, the implementation costs of an announcement are, therefore often presented as low. Negative character traits such as malice can also mean a strategic advantage if they convey the implementation of a threat at lower costs for the originator and thus make it more credible.

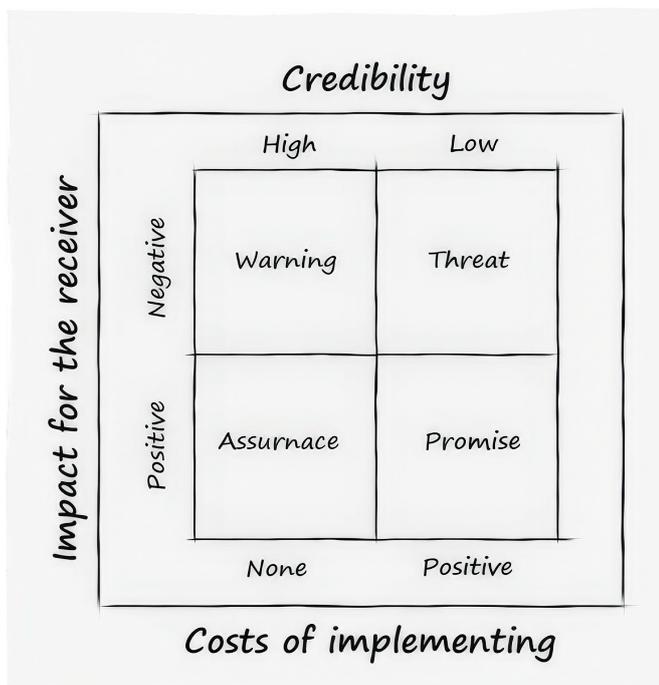


Figure 2: Threats / Warnings / Assurances & Promises.

An announcement whose implementation is free of charge is generally more credible than an announcement whose implementation is associated with costs.

The announcement of an expensive implementation can become credible if non-implementation would lead to higher costs than imple-

mentation. This can be achieved, for example, by building up a good reputation. The non-implementation of an announcement would result in such high costs due to the damage to reputation that the announcements become credible.

The repeated prisoner's dilemma and the evolution of cooperation

How do behavior and incentives change when the same players play the prisoner's dilemma repeatedly? In a repeated interaction, it is possible to react to the behavior of the other side. For example, cooperation on the other side can be answered with cooperation in the next round. However, it is also conceivable to respond to non-cooperation with cooperation in the following round.

In order to evaluate different strategies in the repeated prisoner's dilemma, Robert Axelrod initiated a tournament between algorithms in 1978 (cf. Axelrod, 1980). A total of 14 different strategies took part in the competition. Each strategy competed once against every other strategy, once against itself and once against a random strategy. Each individual interaction was repeated two hundred times and the payoffs were added up across all interactions. At the end of the tournament, the strategy with the highest total score was the winner.

		Player 1	
		Cooperate	Defect
Player 2	Cooperate	Player 1: 3 Player 2: 3	Player 1: 5 Player 2: 0
	Defect	Player 1: 0 Player 2: 5	Player 1: 1 Player 2: 1

Figure 3: Prisoner's dilemma payoffs in the Axelrod tournament.

The game is now understood in a generalized form. The options for action are no longer silence and confessing but cooperating and defecting. Silence corresponds to cooperating and confessing corresponds to defecting. The payoffs used in the Axelrod tournament can be seen in Figure 2.

Before the tournament, it was assumed that algorithms with an exploitative orientation would tend to be superior to well-meaning strategies. An exploitative algorithm attempts to maximize the benefits of the other side's cooperation by defecting itself. A well-meaning strategy, on the other hand, aims to maximize the mutual benefit of cooperation.

Contrary to the expectation that exploitative algorithms would retain the upper hand, however, the tournament results showed a different picture: although the exploitative strategies performed better or just as well relative to their opponents in each individual tournament section, they did not succeed in realizing a sufficient degree of mutual cooperation benefit overall. As a result, a fundamentally well-meaning strategy achieved the best result.

The strategy with the highest score was Tit for Tat (TFT). This strategy initially cooperates and then imitates the behavior of the other side. The tournament showed that successful strategies had the following characteristics:

- They were not „envious,“ i.e. they focused on their overall score and not on their relative performance in a direct comparison of individual interaction.
- Successful algorithms were generally well-meaning, i.e. they usually started with cooperation.
- However, their positive intent was not limitless. Successful strategies were provocative but not vindictive. They sanctioned a lack of cooperation but returned to cooperative behavior when the other side changed its behavior.

- Another characteristic of successful strategies was their simplicity. Some strategies attempted to recognize random strategies. Like a random strategy with equal probability for both courses of action, defecting is the optimal strategy. Too much complexity brings the risk of being miscategorized, which can lead to reduced cooperation.

Even though TFT won the first two Axelrod tournaments, it later became apparent that this strategy is vulnerable if there is a possibility that mistakes will be made. Errors can happen either in the execution or the interpretation of an action (see Imhof et al. 2007). A single incorrectly performed or misinterpreted action can lead to permanently unfavorable results for two TFT strategies (see Table 2).

Strategy	1	2	3	4	5	6	7	8
TFT	C	C	D	C	D	C	D	C
TFT	C	C	C	D	C	D	C	D

Table 1: A single faulty signal (in red) in round 3 leads to permanently unfavorable results in Tit for Tat.

A strategy that works better in an environment of random variation is the Win-Stay Lose-Shift (WSLS). This strategy also starts out well-meaning. If the other side cooperates, the result is interpreted as a win, and the strategy is not changed. If the other side defects, the result is interpreted as a defeat, and the approach is changed in the next round. WSLS can thus quickly return to a cooperative equilibrium. A round of mutual non-cooperation follows the erroneous, non-cooperative signal in round three, but by round five both players have returned to an equilibrium of mutual cooperation (see Table 3). In contrast to a strategy that always cooperates, WSLS benefits from its own random variation (cf. Imhof et al. 2007).

Strategy	1	2	3	4	5	6	7	8
WSLS	C	C	D	D	C	C	C	C
WSLS	C	C	C	D	C	C	C	C

Table 2: A faulty signal (in red) in round 3 leads to negative results, but these can be overcome relatively quickly.

The tournament can also be depicted as an evolutionary dynamic. The successful strategies multiply, while the unsuccessful ones disappear. Exploitative strategies are thus curbed in their development, as their victims can no longer be exploited after their disappearance. The effects of cooperation gains can be amplified in this environment as the opportunities for cooperation increase due to the growth of those strategies that have successfully cooperated.

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If you have any questions, feedback, criticism, topic ideas,
or new registrations, please send them to

newsletter@competitio.de

We will publish our next newsletter in Q2 2024.