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How to become a solar tycoon? The effects of historical and social aspirations on strategic decisions: Evidence from a serious game

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Abstract

Following the Behavioral Theory of the Firm, we conceive of firms? and managers? strategic decisions as a function of performance feedback. We argue that managers are prone to adjust production, R&D investments and sales prices when substantially under- or over-performing their aspirations. We further enquire the influence of respondent characteristics, competitive dynamics and the machine type chosen. We test our assumptions using as a novel combination of a serious game and survey data collected amongst a sample of participants in the Netherlands and Germany. We find strong support for a trade-off between exploration and exploitation. Exploitation is driven by historical success in production as well as an increase in resources. Exploration is driven by an increase in slack resources compared to historical aspirations, but not by direct production feedback or social comparison. Overall the results for historical aspirations seem more consistent than the results for social aspirations.

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ABSTRACT

Following the Behavioral Theory of the Firm, we conceive of firms' and managers' strategic decisions as a function of performance feedback. We argue that managers are prone to adjust production, R&D investments and sales prices when substantially under- or over-performing their aspirations. We further enquire the influence of respondent characteristics, competitive dynamics and the machine type chosen. We test our assumptions using as a novel combination of a serious game and survey data collected amongst a sample of participants in the Netherlands and Germany. We find strong support for a trade-off between exploration and exploitation. Exploitation is driven by historical success in production as well as an increase in resources. Exploration is driven by an increase in slack resources compared to historical aspirations, but not by direct production feedback or social comparison. Overall the results for historical aspirations seem more consistent than the results for social aspirations.

Keywords: Behavioral Theory of the Firm; Aspiration Levels; Decision making; Serious Game

INTRODUCTION

Performance feedback studies (see Greve, 1998, 2003a, 2003c) represent a prominent research stream that helps explaining strategic decisions made by firms. Originating from the Behavioral Theory of the Firm (BTOF) (Argote and Greve, 2007; Cyert and March, 1963; Gavetti et al., 2012) performance feedback models successfully use aspiration levels to explore firm decisions such as organizational change (Greve, 1998), investments in Research and Development (R&D) (Chen, 2008; Chen and Miller, 2007; Greve, 2003a), or acquisitions (Haleblian and Rajagoplan, 2006; Iyer and Miller, 2008). Empirical results have to some extent shown that if performance falls below firms' aspiration levels, firms are more likely to engage in a process of strategic change. Although performance feedback models are now well-established, a number of issues remain unresolved, partly because of the research methods that have been employed. Firstly, the examples mentioned before mostly focus on one type of strategic decision. However, organizational resources are finite and firms have to allocate resources over various activities (Cyert and March, 1963; Levinthal and March, 1993), such as balancing them between "business as usual" and innovation activities (O'Reilly and Tushman, 2004; Raisch and Birkinshaw, 2008), marketing, R&D and operations (Krasnikov and Jayachandran, 2008), or between exploration and exploitation (Lavie et al., 2010; March, 1991). Although the literature broadly recognizes the need to balance resources (Raisch and Birkinshaw, 2008), performance feedback research has not yet delivered many examples of these trade-offs. A notable example comes from Greve (2007) who empirically investigated the trade-off between exploration and exploitation, in the context of innovation. However, to fully understand the strategic behavior of firms, performance feedback models need to take these trade-offs into account.

A second concern relates to the cognitive foundations of performance feedback models. Most of the empirical evidence that has been gathered so far focuses on the aspirations and

strategic decisions at the firm level. However, the BTOF explicitly states that firm behavior is largely the result of compromises between different coalitions of individuals within the firm (Cyert and March, 1963). It is thus important to understand the decisions of individual decision-makers like managers within the firm because they have the overview of the different resources that need to be balanced and are eventually responsible for strategic decisions. After an internal negotiation process, the effects of these decisions may be observed at the firm level. A part of truly understanding these firm level actions is to comprehend the actions of the decision makers within the firm (Ford, 1985). The studies on performance feedback that have been conducted on individuals primarily use self-reported data from surveys or interviews. There is evidence that managers seek more advice from colleagues in case of poor performance, but in contradiction to the BTOF performance model, this results in a smaller likelihood of change (McDonald and Westphal, 2003). Others found that the likelihood of organizational change depends on whether the manager attributes the causes for poor performance to be internal or external (Barker III and Barr, 2002). Overall, it largely remains unknown how the predictions from performance feedback models apply to decision makers within the firm.

Third, studies at the individual level are largely survey or interview-based. These studies generally have a high external validity, but suffer from low internal validity (Bryman, 2013; Campbell & Stanley, 1966). This casts doubt on whether the relationships that are observed actually exist. To complement the survey-based research, some experiments have been conducted to study performance feedback at the individual level (Slevin, 1971; van Rijnsoever et al., 2012). These experiments have high internal validity, however they often lack the realism required to generalize the results to real world strategic decisions. Therefore, it is desirable to conduct experiments under sufficiently controlled conditions to warrant internal validity, but that are realistic enough to generalize results. Recent developments in serious gaming have enabled researchers to develop settings that satisfy these criteria and thus

bridge the gap between laboratory experiments and field studies (Brehmer and Dörner, 1993). Serious games can simulate realistic but controlled conditions under which agents need to make strategic decisions. Currently, they are primarily used for educational purposes (Lewis and Maylor, 2007; Pasin and Giroux, 2011; Salas et al., 2009). Their potential still has to be unlocked in the context of research about strategic decision making, but they can be a valuable addition to current methods (e.g., surveys) in innovation research in general and performance feedback studies in particular.

To deal with these shortcomings, this paper aims to understand how performance feedback influences strategic resource allocation decisions by individuals with regard to investments in production, R&D and price setting. We provide empirical evidence from a competitive serious game called "Solar Tycoon", in which participants had to assume to be a high-tech entrepreneur that has to make strategic resource allocation decisions for their own firm. The game allows us to trace back participants' decision making depending on their own past performance in the game (historical aspirations) and competitors' performance (social aspirations). We find a pronounced trade-off between exploration (investments in R&D) and exploitation (investments in production). Exploitation on the one hand is mainly driven by historical success in production as well as an increase in resources. Exploration on the other hand is driven by an increase in slack resources compared to historical aspirations, but not by direct production feedback or social comparison. This research provides internally valid insights on the resource allocation decisions of individual agents. Thereby, our study informs theories of performance feedback models and demonstrates the applicability of serious games as method to better understand strategic decision making.

THEORETICAL BACKGROUND

The Behavioral Theory of the Firm

The Behavioral Theory of the Firm (hereafter BTOF) (Cyert and March, 1963; Greve, 2003c) has widely been used by scholars to explain differences in firm behavior, emphasizing the relevance of aspirations that influence decision making related to new venture growth and competitors' behavior. The theory comprises three essential elements: (1) firms realize learning curve effects (Argote and Epple, 1990; Arthur and Huntley, 2005; Epple et al., 1991); (2) aspiration levels inform firms about their performance; (3) under- or over-performance in relation to aspirations affects firms' decision making and behavior (e.g., increase investments or R&D expenditures, initiate strategic changes, or exit a market (Cyert and March, 1963; Greve, 1998).[1] The BTOF offers a strong framework to predict and analyze (differences in) managers' decision making and behavior in various contexts including R&D (Chen and Miller, 2007), risk taking (Bromiley, 1991; Gooding et al., 1996; Miller and Chen, 2004; Singh, 1986; Wiseman and Bromiley, 1996), strategic change (Greve, 1998, 2003a), network ties in banking (Baum et al., 2005), corporate illegality (Mishina et al., 2010), acquisitions (Iyer and Miller, 2008), forecasting (Mezias, 1988), growth of new ventures (Delmar and Wennberg, 2007; Wennberg and Holmquist, 2008; Wiklund and Shepherd, 2003), and learning (Baum and Dahlin, 2007; Rhee, 2009).

The BTOF argues that strategic decisions are partly shaped by the aspiration levels, which are "the smallest performance outcomes that would be deemed satisfactory by the decision maker" (Schneider, 1992: 1053). They form "a reference point that identifies the boundary between perceived success and failure" (Baum et al., 2005, p. 538). Firms (or their managers)

[1] Under-performance initiates costly search processes to remedy the situation (problem-based search). Contrasting, over-performance will lead to additional resources, which can be re-invested to sustain a competitive advantage (slack-based search) (see Argote and Greve, 2007; Greve, 2003a). As a result, firms performing at expected or normal aspirations levels are not likely to initiate change or search.

set strategic goals or performance thresholds (e.g., aspiration levels), that the firm and its members should meet and which eventually can be evaluated as either under-performance (failure) or over-performance (success). Aspiration levels are for example derived from a firm's own experience and history or its observation of other firms (Cyert and March, 1963): 123-124) similar to social comparison processes of individuals with reference groups who are similar on relevant attributes (Festinger, 1954; Labianca et al., 2009; Miller, 1982; Wood, 1989).

Previous research demonstrates that comparison to social (performance relative to referent firm(s)) and historical (firm's own past performance) aspiration levels exert a different influence on managers' decision making (Greve, 1998, 2003a; Greve, 2003b; Kahneman and Tversky, 1979; March and Shapira, 1992).

Empirical work on the impact of historical aspiration levels on firms' risk taking behavior and change reports fairly consistently that risk taking increases below a threshold aspiration level and decreases above a threshold aspiration level (Greve, 1998, 1999; Iyer and Miller, 2008; Miller and Chen, 2004).

In contrast, the work on social aspirations and organizational change has yielded mixed and contradictory findings regarding the direction of the effect (Audia and Greve, 2006; Miller and Chen, 2004); some scholars provide evidence that the distance between the firm's current performance and its social aspiration levels leads to more change (e.g., Ketchen and Palmer, 1999), some to less (e.g., Greve, 1998) some to riskier or more radical change (e.g., Harris and Bromiley, 2007) and some to less risky change (e.g., Iyer and Miller, 2008). Alternatively, decision makers may combine information on social and historical aspirations complementarily when making sense of performance feedback (Chuang and Baum, 2003) rather than shifting attention towards either historical or social aspirations. Research shows that managers prefer either of these reference frames in different situations: they rely on social aspiration levels when they perceive their firm as similar to others, and rely on historical

aspiration levels when they view their firm as exceptional (Greve, 2003b). As such, both social and historical aspiration levels can serve as intuitive decision making heuristics for managers (Nisbett and Ross, 1980): available data on own and comparable other firms' performances are pooled with simple heuristics to create an anticipation of future performance (Baum et al., 2005; Greve, 1998).

In sum, different specifications of aspiration levels can lead to different results, and thus inhibit a comparison across studies (Washburn and Bromiley, 2012). Therefore, it is important that the concepts for aspiration levels and the types of strategic decisions are grounded in theory.

Dependent variable: strategic decisions

In this paper, we focus on how aspiration levels influence three types of decisions: investments in production, investments in R&D and the firms' pricing behavior as a form of strategic reaction. We particularly focus on these three dependent variables because they belong to the central strategic decisions and discriminating factors of firms and their managers operating in competitive environments (Leland, 1972; Mills, 1984; Pindyck, 1982). Adjusting any of those three mechanisms can lead to the differentiation of a firm, better performance and thus a competitive advantage as compared to its competitors in the same industry.

Production decisions relate to a firm's generation of new stock of products. While high levels of stock availability are costly, firms try to produce just in time as well as focus on so called lean production. Nevertheless, it is commonly assumed that firms try to downsize production in the face of decreasing or fluctuating demand because it either causes diminishing returns or costs of adjusting production (Mills, 1984; Pindyck, 1982). Against this background, a temporary drop in demand would result in some net accumulation of stock as the firm only partially adjusts its rate of production. As a result, firms accumulate stock because: 1) "Firms cannot short sell their products without cost; and 2) production decisions

are made in advance, before the state of demand is fully known" (Kahn, 1987: 668). Theoretically, production is the core activity of the firm that is conditional on sales. As such, it can be seen as an example of routinized behavior that exploits the existing knowledge and capabilities of the firms (March, 1991).

R&D investments refer to a firm's expenditures in new product development, innovative production processes, research projects and in future technological developments that are assumed to put the firm at a competitive advantage if successful. Maintaining high R&D levels is especially important in industries where time-to-market and the product and innovation life cycles are short, and ongoing new product differentiation is essential (Lancioni, 2005). R&D, in its essence, is a cost. Therefore, from a cost perspective, a straightforward way to raise return on assets would be to reduce or stop it (Gavetti et al., 2012). Nonetheless, managers seeking to improve their firm's performance are more likely to search for innovative solutions to cope with current problems and hence invest in R&D and new product development (Gavetti et al., 2012). As such, R&D investments can be seen as an example of exploration (March, 1991).

Sales price setting on the other hand is a strategic decision that does not require expenditure (Dutta et al., 2003; Rao et al., 2000). Pricing describes a firm's competitive activities to set sales prices by interpreting and integrating different types of information simultaneously (e.g., costs, competitive factors, customers' willingness to pay, corporate objectives, regulatory constraints). From a resource-based perspective, pricing is a complex process which involves gathering, sharing and interpreting huge amounts of information and thus requires resources and coordination (Ingenbleek et al., 2003). A firm therefore has to balance resources and develop a capability of setting the right price to appropriate value and

capture rents (Dutta et al., 2003).[2] According to the Behavioral Theory of the Firm, which argues that prices may be set to balance competing interests, rather than to maximize profits, a firm's price-setting is driven by past performance and strategic choices (Dutta et al., 2003). Market intelligence can help to set the right price whereas market sales data from the past are the most reliable source. Nonetheless, this information is sometimes difficult to obtain as firms often do not know what competitors do.

Independent variables: performance feedback

Performance indicators are the most widely used dependent variables in business and management research including but not limited to growth, profit, size, liquidity, success/failure, market share and leverage (Murphy et al., 1996; Richard et al., 2009). Because of too many definitions, different approaches and even negative correlations between some performance measures (Cooper, 1993; Murphy et al., 1996), comparison between scientific studies is difficult and can lead to inconsistent results (Chenhall and Langfield-Smith, 2007; Richard et al., 2009). This is also true for previous studies measuring aspiration levels. Therefore, scholars argue to use a combination of measures to get a more objective picture of the relationships investigated (Wiklund and Shepherd, 2005).

We consider a number of performance feedback variables to influence strategic decisions of firms. Historically based performance measures are: change in sales, change in financial slack and success in R&D. Socially driven performance measures are firm differences with regard to: financial slack, product quality and pricing. Particularly important for socially driven performance measures is to establish the reference groups firms compare themselves to (Hu et al., 2011; Knudsen, 2008), but little research has been conducted on this topic (Massini et al., 2005). There are different possibilities to define reference groups. The most

[2] A price that is too low may spill some of the value created to the customer. Contrasting, a price that is too high causes a lower quantity to be sold and thus, increases the product stock (Dutta et al., 2003).

straightforward is to define the population of competing firms as reference group (DiMaggio and Powell, 1983; Greve, 1998; Knudsen, 2008). Another approach is to make a distinction within the population based on a performance measure like innovativeness (Massini et al., 2005) which means that the firm only compares itself to the most innovative market players when it considers itself also as an innovative firm and vice versa. Thus, establishing a performance measure for a reference group requires that this group reflects part of the firm's identity (Dutton and Dukerich, 1991). Moreover, this performance measure needs to be observable by others, which depends on how firms account for their performance. In this paper we define the reference group by the technology base the firms use. We make a distinction between firms that base their products on high-cost, high-quality technology and low-cost, low quality technology. Both technologies lead to products that fulfill the same service (Saviotti and Metcalfe, 1984) and thus compete on the same market.

For each performance measure we hypothesize why they are related to different types of strategic decisions, and in case of social performance measure, what the expected differences are per technology category.

Change in sales

Performance above historical aspirations in the context of sales means that the firm has sold more products than in the previous period, while performance below historical aspirations means that the firm sold less units.

Production: Sales directly influence production volume. If sales are above aspirations production will be maintained or possibly expanded, as organizations and individuals generally repeat and incrementally improve successful behavior (Kaplan and Henderson, 2005; van Rijnsoever et al., 2012). Under-performance in the previous period leads to more products being left on stock. In the following period, the firm will downsize its production and attempt to first sell the products that are in stock.

R&D investments: Studies on different industries (Chen, 2008; Chen and Miller, 2007) and the Japanese shipbuilding industry, in particular, demonstrated that aspirations based on past performance are a strong predictor of R&D spending (Audia and Greve, 2006; Giachetti and Lampel, 2010; Greve, 2003a, 2007, 2008; Vissa et al., 2010). This is because the firm can afford to take the risk to invest in strengthening its position further (Barney, 1991; van Rijnsoever et al., 2012).

Sales price: In line with theory about demand and supply, over performing firms can afford to raise their prices as there is more demand for the product than expected. Under-performing firms on the other hand might be forced to lower their price.

This leads to the first hypothesis.

H1: There is a positive relationship between change in sales and (a) production, (b) R&D investments and (c) sales price.

Change in financial slack

In this paper a firm's financial slack is conceptualized as the amount of liquid financial capital that the firm has at its disposal for strategic investment. Financial performance above historical aspirations implies that the firm's slack has increased during the previous period, while performance below historical aspirations signifies a decrease in slack. The growth of these slack resources is driven by sales above aspirations. These slack resources are then invested in both exploitation and exploration (March, 1991).

Production: Earlier research shows that organizational slack increases the growth of production assets (Greve, 2003b), which means that the firm can invest those additional resources in strengthening its existing competences (e.g., exploitation). Although, managers of firms under-performing their aspirations may have the incentive to decrease the performance – aspiration gap by pushing for more extensive changes of the firm's strategic

actions and their production processes in particular (e.g., Levinthal and March, 1981; Singh, 1986), they do not have the additional resources at hand. Thus, the greater the under-performance, the less likely the firm manager will be able to invest in production assets. Therefore we expect a positive relationship between financial slack and production.

R&D investments: As discussed above slack resources indicate that the firm can afford to take the risk to invest in the exploration of new alternatives (Barney, 1991; Greve, 2003a; March, 1991; van Rijnsoever et al., 2012). As the firm accumulates additional resources it will thus be more likely to invest this slack in R&D that may potentially lead to a sustained competitive advantage. Thus, organizational slack increases firms' incentives to expand current successful routines and practices. However, a decrease in financial slack inhibits the firm to invest in explorative R&D efforts, because these resources are needed to keep operational processes going.

Sales price: Most studies have investigated the impact of slack on risk-taking or subsequent performance (Singh, 1986) but there is no consistent evidence or plausible argument for the existence of a relationship between abundant financial slack in comparison to historical aspirations and price setting. Therefore, we do not expect a relationship between a firm's change in financial slack and sales price.

Based on the aforementioned arguments, we propose:

H2: There is a positive relationship between change in financial slack and (a) production and (b) R&D investments.

Success in R&D

In this study previous success in R&D relates to high-risk investments in developing new or improved products that have led to innovations being sold on the market.

Production: There is no consistent evidence or plausible argument for the existence of a relationship between successful product R&D in comparison to historical aspirations and production. Greve (2003b) for example only investigates firms' subsequent investments in production assets such as machinery but not in (production) output itself. Moreover, he focuses on ROA (return on assets) as aspiration level measure. Therefore, we do not expect a relationship between previous success in product R&D and production.

R&D investments: Firms that had successful R&D investments have developed the knowledge base (Agrawal and Henderson, 2002), absorptive capacity (Cohen and Levinthal, 1990) and routines (van Rijnsoever et al., 2014) that allow them to repeat the same process more efficiently in the future. Moreover, firms that invest in R&D can do this as part of a deliberately chosen corporate strategy by deciding to be a leader in product quality rather than in price (Porter, 1991). Such a product leader strategy increases the likelihood of repeated R&D investments.

Sales price: R&D investment whether successful or not comes at certain costs which will be reflected in higher prices passed on to customers. In return, customers will get a higher quality as well which justifies firms setting higher sales prices (Garvin, 1984). This is specifically the case when the strategy of the firm is to target the high-end of the consumer market with premium, but more expensive, products. The theoretical argument about the relationship between quality and price is bi-directional. Moreover, the empirical results are equally mixed depending on the amount of information available to consumers (Garvin, 1984). On the one hand, quality and price are assumed to be positively correlated (Gabor and Granger, 1966; McConnell, 1968). According to economic theory, higher quality can only be produced at higher cost, and if costs and prices are positively related, then quality and price will also co-evolve (Riesz, 1979). Once managers observe this behavior, they may then respond by readjusting prices.

Empirical evidence from market data about the relationship between R&D success and price drastically fluctuates by product category. For nondurable goods studies mostly show a weak or negative correlation between price and quality, while for durables they find a significant positive correlation (Riesz, 1979). As solar panels are a durable good we expect a positive relationship.

Therefore:

H3: There is a positive relationship between success in R&D and (a) R&D investments and (b) sales price.

Difference in financial slack

In our model, this variable indicates the value of a firm in relation to its competitors. A firm that performs above aspirations has experienced success and can therefore afford to expand its current production to live up to its earlier success and invests its slack in other future-oriented scenarios such as its production capacity to sustain its competitive advantage in the long run. Thus, firms performing above their aspiration level will only make minor adjustments to existing routines and strategies such as the current production (Baum et al., 2005; Labianca et al., 2009).

Production: Over-performance re-affirms a firm's current strategy and leads to a market leader position and abundant slack resources. The firm has an advantaged position to its competitors and will thus reinvest its slack resources in order to expand its current competitive advantage in the long run (Greve, 2003b). A firm that significantly performs below average has a strong incentive to catch up but does not possess the necessary resources to do so (Chen and Miller, 2007). Thus, we hypothesize a positive, linear relationship between the difference in financial slack and production.

R&D investments: Over-performing firms are reinforced in their current ways of doing business and thus, current routines seem to work just fine. As a result, they have little

motivation to change leading to a lack of incentive to invest in innovation (Cyert and March, 1963; Iyer and Miller, 2008). Lower performing firms cannot take these risks either as they do not possess the necessary resources (Gentry and Shen, 2013). According to attention-based theory (Ocasio, 1997) managers then shift their focus from aspirations to survival particularly when performance is so low that their firm is close to bankruptcy (Audia and Greve, 2006; March and Shapira, 1992; Miller and Chen, 2004). Therefore, we do not expect a significant relationship between difference in financial slack and R&D investments.

Sales price: Finally, performance above the social aspiration level confirms a firm's current pricing strategy. The firm then assumes that it could also charge a higher price as there obviously is a high demand for its products.

H4: There is a positive relationship between difference in financial slack and (a) production and the (b) sales price.

Difference in product quality level

This social aspiration level is based on the contemporary performance of a reference group of firms which is all other firms in a market. Competitive comparisons, market observations and analyses belong to firms' daily routines. Furthermore, the competitive environment provides a source of rich information and is thus a very important indicator for potential threat: a firm that under-performs in direct comparison with competitors, experiences high competitive discrepancy which in most cases will be interpreted as failure (Milliken and Lant, 1991).

Production: In case a firm produces at a higher quality level than its competitors (i.e. it successfully invested in R&D), it will be more likely to increase its offer of high-end product as it has kind of a niche position. Better products will increase the demand. Thus the firm needs to produce more.

R&D investments: Moreover, it will invest fewer resources in R&D as it already is a quality leader in the market. There are decreasing marginal returns on investment, meaning that if the firm already is a product market leader, additional investments are useless. Furthermore the successful firm does not want to be too far ahead of competition as this may send a divergent signal to customers potentially causing cognitive dissonance.

Sales price: However, regarding the sales price, firms offering a better product quality than competitors are more likely to charge higher prices. They are aware of their monopolistic position by producing at a higher quality and will try to maximize their profits by charging a higher price. Moreover, they can produce more as they are able to stimulate the demand for their products and raise sales based on their monopoly position. Thus, we expect:

H5: When *the firm's product quality level* relative to the social aspiration level increases (a) production increases, (b) R&D investments decrease and the (c) sales price increases.

Price difference

A firm charging higher prices than its competitors for a similar product will most likely sell fewer items. Particularly, pricing strategies can be adjusted without any costs and show a firm's reaction to current competitive dynamics in the market.

Production: There is no plausible argument for the existence of a relationship between differences in prices in social comparisons and production. Therefore, we do not expect a relationship between price difference and production.

R&D investments: There is no plausible argument for the existence of a relationship between differences in prices in social comparisons and R&D investment. Therefore, we do not expect a relationship between price difference and R&D investment.

Sales price: When the manager realizes that he charges a much higher price than his competitors in the market, he will adjust his price accordingly. Based on the aforementioned arguments, we propose:

H6: When *the firm's* unit price relative to the social aspiration level increases the (a) sales price decreases.

At the same time, we suggest that the relationship between aspiration levels and decision making (production, R&D investments, pricing) to be influenced by the firm's resource base, specifically its human capital; that is the manager's education and background. Jointly, these variables should influence whether managers consider engaging in search or change processes, yet they should also shape the relationship between firms' aspiration levels and their strategic behavior differently.

METHODS

Serious games

We tested our hypotheses using a serious game about the management of a solar panel company called "Solar Tycoon". These games usually represent a simplification of real life (Keys, 1986; Keys, 1988, 1990) and thus have mostly been used as teaching tool in business schools but they comprise enough illusion of reality, to induce real world-like responses from players (Wells, 1990). A serious game thus describes "a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (Zyda, 2005: 26). It is referred to as "serious" to highlight a usage that is not related to pure entertainment[3] because it covers many aspects of real-life business situations such as strategy, marketing, finance, standardization, technology management, operations management and human resources (Salas et al., 2009).

[3] This relates to more traditional computer games.

When playing the game, corresponding sequences of reports on results of the decisions are fed back to the players, often very soon after decisions are made. The players are only given incomplete information in advance to see how their choices will influence operations and the consequent reports. A major problem (sometimes the major problem) is therefore to "learn from experience", while playing, how the game really works (Keys, 1988, 1990; Salas et al., 2009). Moreover, it is possible to manipulate and create different experimental conditions to measure behavioral differences. Finally, although the games cannot provide the equivalent of experience in business, they do provide a practical tool for adding to the manager's practical decision making (Andlinger, 1958; Jackson, 1959; Wells, 1990).

Until now, serious games have mostly been used for education purposes. However, when serious games are sufficiently realistic, but still provide controlled condition, they can be a suitable tool to conduct research on.

Sample and data collection

The participants of the study were students from different departments of Utrecht University in the Netherlands and the Technical University Berlin in Germany. The participants were recruited on campus and via mailing lists. They were promised to receive a fixed financial reward for participation and a flexible reward dependent upon performance. There are two factors that determine whether the use of student samples is appropriate (Stevens, 2011) for the purpose of our research. The first refers to the scope of the theory. A theory can be formulated universalistically or particularistically (Kruglanski, 1975). A universalistic theory applies to all populations and therefore a student sample is not inherently better or worse than any other sample. In contrast, particularistic theories are context-dependent demand and thus, represent the population characteristics of the specific setting. Since our hypotheses are based on previous scholarly contributions and are consistent with individual and firm-level arguments, our research contributes to more general and

universalistic theories. However, we are particularly interested in applying the theory to innovation decisions in a start-up setting. Therefore, we apply it to a specific context using a serious game setting allowing us to transfer the universalistic research context to a more realistic setting. The second factor referred to by Stevens (2011) relates to the primary goal of the study which can either be demonstrating internal validity or to optimizing external validity. Experimental settings such as the serious game are characterized by a high internal validity and a low external validity, due to the artificial setting and homogeneity of the sample (Campbell and Stanley, 1966).

In sum, despite the universalistic nature of our theory the choice of sample is not entirely irrelevant (Stevens, 2011) because of the inherent differences between individuals and entrepreneurs. However, we acknowledge these discrepancies and do proceed with caution (see the discussion above). Given that our game simulates decisions made in small enterprises, we suggest that the results of this study generally apply to less complex firms (see also van Rijnsoever et al., 2012). Furthermore, many of the study participants are familiar with the concept of innovation and we control for individual differences. Thus, we are confident that our results are transferable to a real life situation.

The total number of participants was 155 ranging in age from 17 to 41 years (mean age: 24.5 years). The group consisted of 111 men and 44 women. 61.3% of the participants were familiar with the topic of innovation because they followed a bachelor or a master program related to innovation management.

However, there were no noticeable differences in outcomes between these students and those that followed other programs. The subjects were divided into groups of 5–9 members. To enhance motivation, all were promised a reward relative to their performance in the game, the average being € 16.52 for a participation time of 90 min. Subjects were told that they are taking part in a game and had the opportunity to earn money at the end depending on their performance in the game. The goal of the game was stated clearly: the participants should

attempt to bring their firms successfully to market and let them grow. Participants were distributed a questionnaire containing a number of questions designed to measure personality characteristics, demographics as well as gaming, industry and entrepreneurial experience before playing the game. A second questionnaire measuring the participants' behavior and emotions in the game and their risk tolerance was distributed after participants had finished playing the game. Additionally, every player received a booklet with the goals, rules and instructions of the game before the game started. In all game sessions in the Netherlands and Germany, the same researcher was present to instruct the players and announce the rounds of the game.

Procedure serious game

The game was played in sixteen rounds (4 years à 4 quarters). Participants were put in a fictitious but realistic decision making setting around the serious game "Solar Tycoon". They had to assume that they are entrepreneurs in the high-technology solar panel industry and that they recently received € 300,000 as a loan from the bank. All players in one session were competitors in the same industry and thus produced solar panels at various qualities and prices which they wanted to sell to their customers. The participants had no information on the demand as well as the number of potential customers but they were told that consumers have a preference for price (per m^2) and quality (kWh/m^2). Therefore, the game comprises an artificial market in which consumers randomly seek the market and choose the first option that satisfices their utility on both dimensions. The number of customers purchasing solar panels is fixed for every quarter but new consumers entered the market every round.
In the first round, participants decided between two different machines "Polycrystalline" and "Monocrystalline" producing solar panels. Both machines have the same price (€ 150,000), but have different characteristics which are displayed in Table 1. The Polycrystalline machine

produces solar panels at a lower quality and for lower costs than the Monocrystalline machine.

Insert Table 1 about here

Based on their initial decision on the respective machine, two markets – one for high-end and one for low-end products – were created. Each of the machines thus formed the reference category for participants' comparison with their peers and competitors in the game.

In the second round, players were now able to start the production process and decide on how many entities of solar panels they wanted to produce. Another decision they could make beginning from round two was whether they wanted to invest in R&D. Expenditures on R&D in Euro were helpful to improve either the quality (the letter "E" specifies the lowest quality and "A" the best) or the maximum production quantity (more solar panels can be produced with one machine per quarter) or both for the respondents' machine(s). Every participant initially started with producing solar panels at the lowest quality level "E" which with successful R&D could be improved up to level "A". Moreover, R&D investments were irreversible. The players were told that R&D is a chance process and the chances of success can be increased the higher the amount invested. In case of a successful investment, participants only produced panels at the higher quality level.

The third round, after the players had produced solar panels, they were able to set a sales price per panel. Figures 2-4 show exemplary screen shots of the first three rounds of the game.

Insert Figures 2-4 about here

After the first three rounds of the game and when the participants had adjusted to the game's features and decisions they could make, each decision making round lasted two minutes.

At each round, decisions repeated themselves and the subjects could decide whether they wanted to:

- produce new panels;
- invest in quality (product innovation);
- set a new sales price in Euro per panel.

After each round, the participants were fed back with information regarding their individual performance as well as the performance of their competitors without knowing which player belonged to which fictitious firm. Current quality levels, prices, the machine type as well as the financial slack of each firm were observable for all participants throughout the game.

After all sixteen rounds, the game was concluded and all players were paid their rewards based on their performance ranking shown in the game.

Measures

Dependent variables

We are using different indicators for each of our dependent variables as shown in the conceptual model. Production is measured as the number of solar panels the player decided to produce in a given quarter. Further, we measure R&D investments by a player in a given quarter as investments in the increase in quality level (e.g., yield per square meter)[4]. Finally,

[4] We also measured investments in production increase per machine. However, players invested very little in this option, so we did not include it in our analyses.

sales price is measured as the price in Euros the player asked for a solar panel in a given quarter.

Independent variables

We measure aspiration levels for the different performance indicators participants received. Historical aspiration levels are measured as changes in performance during the last two periods (t-1 and t-2). Change in product sales is the change in the number of units sold between the last two periods. Change in financial slack is measured as the change in Euros the firm had between the last two periods. Success product R&D is measured as a dummy variable that indicates whether the level of production quality has increased or not between the last two periods.

Social aspiration levels are measured as the performance relative to the average performance of other players at t-1. As such, we calculate the difference between a players' performance and the mean performance in a given quarter. Financial slack difference is measured as the difference from the average financial slack. Price difference and quality difference are machine specific, which means that the reference group is limited to other owners of a specific machine. Price difference is measured as the difference from the average price for panels for a given machine type. Quality difference is measured as the difference from the average quality level for a given machine.

Control variables

Firm control variables

As in the beginning of the game, participants could choose one machine, we control for the machine type. Moreover, we control for the firms' current financial slack, products sold and the different quality levels they could reach for successful product R&D investment.

Respondent characteristics

In the questionnaires we measured, among other things Entrepreneurial Self-efficacy (ESE), which is a characteristic that has been used to predict the likelihood of an individual being an entrepreneur. ESE refers to the degree to which individuals believe they are capable of successfully performing the various roles and tasks of a new venture (Chen et al., 1998). Thus, a growing number of studies include ESE to measure its impact on entrepreneurial motivation, intentions, and behavior (McGee et al., 2009). Another scholarly contribution shows that founders' levels of ESE are higher when their ventures make decisions in ways that involve other employees, that are more comprehensive, and that incorporate more current information (Forbes, 2005). We assessed ESE with four different items on a five-point Likert scale (completely disagree to completely agree with a defined neutral point) in line with Gatewood et al. (2002), Cassar and Friedman (2009) and Edelman et al. (2010).

In addition we measured on a five point scale the respondent's familiarity with innovation-related topics and the solar panel industry. We further asked whether participants own or owned a business before (yes/no).The descriptive statistics and correlations between variables are presented in Table 2.

Insert Table 2 about here

Statistical method

We fitted a series of time series models to model strategic decisions as within respondent observations, with time accounted for as fixed effect dummies. This was done using the PLM package of the R-program (Croissant and Millo, 2008). We regressed each dependent variable on the series of independent variables starting from quarter three of the game because first the first three rounds did not record any sales and because participants needed some time to adjust

to the game's features[5]. Moreover, we added the firm control variables at t-1 and the respondent characteristics to the model[6]. Since different machine types also imply different reference groups, we interacted all these variables with a dummy for machine type. This produced separate indicators for owners of Monocrystalline and Polycrystalline machines as reference groups. If an interaction term is significant, then this means that there are differences between machine types. Finally, we added a series of dummy variables to the model that indicated the experimental group.

RESULTS

First, we tested if there was a relationship between respondent characteristics and machine choice using a binary logit model; no significant relationships were found. Moreover, we found that in all games Monocrystalline machine owners eventually outperformed Polycrystalline machine owners, which means that a strategy of innovation quality improvement worked better than a focus on quantity and low prices. This information was never available to participants. The results of our panel regressions are provided in Table 3.

Insert Table 3 about here

The Monocrystalline columns show the estimators and significance levels for Monocrystalline machine owners. The estimators and significance levels in the Polycrystalline columns represent interaction effects. They show whether there is any significant difference between the indicators for Polycrystalline machines and

[5] We extensively tested squared relationships. However, no plausible squared relationships were uncovered.

[6] We did not add age and education level, since these variables showed little variation within our sample. Moreover, the effect of age is captured by the variables for participants' experience. We also did not include gender, as these effects were captured by the other respondent variables.

Monocrystalline machines. The size of the respective Polycrystalline coefficient is obtained by adding up the coefficients for both Monocrystalline and Polycrystalline indicators.

Starting with historical aspirations, the positive estimators of products sold change and production and price support H1a and H1c. Surprisingly, we do not find support for H1b. Sales do not seem to be a predictor of a firm's R&D investments as suggested by previous research. In the context of the game, participants did not use sales as signaling indicator for R&D. There are no differences between machines.

The estimators for financial slack change and production and R&D investments support H2a and H2b, but the relationship for production is significantly less strong for Polycrystalline machines. This can be explained by the fact that the variances in production for Polycrystalline panels were lower than for Monocrystalline panels. The positive relationship for R&D investments means that slack change (e.g., profit) has a stronger signaling value than the number of products sold. Overall, an increase in financial slack is positive for exploration and exploitation. As expected, there is no relationship with price.

For product R&D success, we find no effect for increase in R&D investments. Polycrystalline is significantly different from Monocrystalline, but the overall estimator does not differ from zero, which rejects H3a. H3b is only confirmed for Monocrystalline machines. This is likely because only these firms were in a position to differentiate themselves by quality at the top end of the market, and could thus ask high prices. Polycrystalline firms could not follow this strategy, as there would always be better Monocrystalline panels on the market. This partially supports H3b.

Next, we turn to social aspirations. For financial slack relative to the social aspiration level, we find that it has no signaling value for production, which means that there is no support for H4a. However, we do find support for H4b about the positive relationship with sales price. Furthermore, the data unexpectedly reveal a significant positive relationship

between a difference in financial slack compared to other participants and product R&D investments for Polycrystalline machine owners.

We find that an increase of quality as compared to other participants increases production of new Monocrystalline panels, and to a lesser extent Polycrystalline panels, which confirms H5a. An increase in the difference of quality when comparing to their peers, led to a reduction of investments in product R&D for Monocrystalline panels, but not for Polycrystalline panels. This effect can be explained by the fact that the quality leadership strategy only worked for Monocrystalline. Polycrystalline panels were never the best panels on the market, and could thus strategically 'pause' their R&D investments. This partially rejects H5b.

For Monocrystalline machine owners we find a negative relationship between quality level difference and sales price, which is again not significant for Polycrystalline machine owners, rejecting H5c. One explanation for this effect could be that the firms with highest innovation levels could afford not to invest in innovation anymore, which allowed them to ask lower prices.

We find no effect of price difference on sales price, implying that firms use other signals to set their sales price. This rejects H6.

The respondent characteristics also influenced firms' strategic decisions. Entrepreneurial self-efficacy (ESE) negatively influences product R&D investment for Monocrystalline machines, but is positive for Polycrystalline R&D investments. Thereby the behavior of people scoring high on ESE is contradictive to the general trend of higher R&D investments for Monocrystalline.

Familiarity with innovation leads to less investments in production and more in R&D for Monocrystalline machine owners. This emphasis on exploration rather than exploitation fits with the strategy associated with the machine. In contrast, familiarity with the solar industry exerts a positive influence on the production of panels and a negative influence on R&D investments, particularly for Monocrystalline machines. Industry familiarity seems thus to

lead to exploitation rather than exploration. Finally, owning a business also leads to more production for both machines.

Using an ordinal logit model, we also tested whether these respondent characteristics exerted any influence on the final rankings of financial slack after the last round, which was the prime indicator for winning the game. However, except that Monocrystalline machines outperformed Polycrystalline machines, we did not find any significant relationships.

DISCUSSION AND CONCLUSION

The panel regressions demonstrate that historical and social aspirations matter in strategic decision making. Furthermore, the decisions significantly depend on whether firms offer high-end or low-end products on the market. Thus, the evolution of these two distinct groups emphasizes the different extant market needs and demand.

We observe a pronounced trade-off between exploration (investments in R&D) and exploitation (investments in production). Exploitation on the one hand is mainly driven by historical success in production as well as an increase in resources. Moreover, difference regarding product quality compared to competitors drives production, but this depends on the machine type.

Exploration on the other hand is driven by an increase in slack resources compared to historical aspirations, but not by direct production feedback or social comparison. It is particularly the spare resources that determine this investment. Moreover, the differences in the two categories of financial slack might also be due to inconsistent performance feedback which means that a firm can perform above average on its historical aspiration level but below average on social aspiration standards and vice versa. In this study we did not focus on inconsistent performance feedback but emphasize that this provides a worthwhile and promising avenue for further research.

Sales price is driven by sales in reference to historical aspiration levels and previous investments, though this differs by machine. Price-setting heavily depends on the machine strategy and thus the price segment the firm operates in (low-end vs. high-end market), but not on social comparison.

Overall the results for historical aspirations seem more consistent than the results for social aspirations that are more contingent on the machine type. In this controlled setting we show to what extent which performance feedback mechanism provides information to individual managers on how to balance their investments. By not solely focusing on one indicator for each aspiration level, but by integrating different indicators we have provided a richer picture of what factor most strongly drives managers' decision making in the context of the BTOF. Valuable addition to this research lie in testing the relationships we found in real-life settings. We believe that using quantitative data from actual firms to confirm the trade-offs we find would be value added to the BTOF community. A further worthwhile exercise to advance our study would be to add and control for other relevant variables such as IP or patent protection in the game and see whether the behavior of the participants remains consistent or changes. It would further be interesting to set the game in other innovative or high-technology contexts and see whether the results will hold.

This study has a few limitations; our homogenous sample only consists of students and no managers. However, the principles of the game and the students' decisions/reactions are universalistic. Our participants followed the settings of the game. If conditions had changed (for example different market demand, this might lead to different results). Future research should therefore look at the role of different settings and environmental change on the choices. Nonetheless, the game is more realistic than other methods employed, but given the nature of a simulation game it is no representation of reality and hence no real choice situation. It however provides a controlled environment and is a very good approximation of real-life decision making in an innovation context. We are profoundly convinced of the

game's realism for two reasons: 1) the players behaved highly competitive and 2) the results are mostly in line with theory. The distinct impact of the two machines might be due to a selection effect as shown by the respondent characteristics. In sum, we strongly believe that serious games are an interesting addition to the current set of methods.

Using this methodology allows us to confirm previous findings of performance feedback studies and add other interesting variables to the models such as respondent characteristics. Therefore, we would like to encourage future research to apply realistic game settings in order to understand the microfoundations of strategic decision making in the context of performance feedback studies.

Our research shows that investing in exploration and balancing resources between the two (becoming ambidextrous) provides the greatest chances of long-term survival and success. Therefore, governments and policy-makers should raise awareness in (particularly smaller) firms to achieve their full potential by tapping into both forms of investment. Furthermore, this game can serve as an educational tool for students and practitioners alike. Practitioners can use the game to better understand the consequences of their decisions and how to learn from them. Moreover, employing the game in education firm managers can be taught about how to efficiently balance their resources to achieve optimal returns on investment.

Thus, policy can provide the legal framework/environment to stimulate simultaneous investments in both exploration and exploitation as well as offer workshops for firms and disseminate educational games.

REFERENCES

Agrawal, A., Henderson, R., 2002. Putting Patents in Context: Exploring Knowledge Transfer from MIT. Management Science 48 (1), 44–60.

Andlinger, G.R., 1958. Business Games-Play one! Harvard Business Review 36 (2), 115–125.

Argote, L., Epple, D., 1990. Learning curves in manufacturing. Science 247 (4945), 920–924.

Argote, L., Greve, H.R., 2007. A Behavioral Theory of the Firm —40 Years and Counting: Introduction and Impact. Organization Science 18 (3), 337–349.

Arthur, J.B., Huntley, C.L., 2005. Ramping up the organizational learning curve: Assessing the impact of deliberate learning on organizational performance under gainsharing. Academy of Management Journal 48 (6), 1159–1170.

Audia, P.G., Greve, H.R., 2006. Less Likely to Fail: Low Performance, Firm Size, and Factory Expansion in the Shipbuilding Industry. Management Science 52 (1), 83–94.

Barker III, V.L., Barr, P.S., 2002. Linking top manager attributions to strategic reorientation in declining firms attempting turnarounds. Journal of Business Research 55 (12), 963–979.

Barney, J., 1991. Firm Resources and Sustained Competitive Advantage. Journal of Management 17 (1), 99–120.

Baum, J.A.C., Dahlin, K.B., 2007. Aspiration Performance and Railroads' Patterns of Learning from Train Wrecks and Crashes. Organization Science 18 (3), 368–385.

Baum, J.A.C., Rowley, T.J., Shipilov, A.V., Chuang, Y.-T., 2005. Dancing with Strangers: Aspiration Performance and the Search for Underwriting Syndicate Partners. Administrative Science Quarterly 50 (4), 536–575.

Brehmer, B., Dörner, D., 1993. Experiments with computer-simulated microworlds: Escaping both the narrow straits of the laboratory and the deep blue sea of the field study. Computers in Human Behavior 9 (2–3), 171–184.

Bromiley, P., 1991. Testing a causal model of corporate risk taking and performance. Academy of Management Journal 34 (1), 37–59.

Campbell, D., Stanley, J., 1966. Experimental and Quasi-Experimental Designs for Research. Houghton Mifflin Company, London.

Cassar, G., Friedman, H., 2009. Does self-efficacy affect entrepreneurial investment? Strategic Entrepreneurship Journal 3 (3), 241–260.

Chen, C.C., Greene, P.G., Crick, A., 1998. Does entrepreneurial self-efficacy distinguish entrepreneurs from managers? Journal of Business Venturing 13 (4), 295–316.

Chen, W.-R., 2008. Determinants of Firms' Backward- and Forward-Looking R&D Search Behavior. Organization Science 19 (4), 609–622.

Chen, W.-R., Miller, K.D., 2007. Situational and institutional determinants of firms' R&D search intensity. Strategic Management Journal 28 (4), 369–381.

Chenhall, R.H., Langfield-Smith, K., 2007. Multiple Perspectives of Performance Measures. European Management Journal 25 (4), 266–282.

Chuang, Y.-T., Baum, J.A.C., 2003. It's All in the Name: Failure-Induced Learning by Multiunit Chains. Administrative Science Quarterly 48 (1), 33–59.

Cohen, W.M., Levinthal, D.A., 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Science Quarterly 35 (1), 128–152.

Cooper, A.C., 1993. Challenges in predicting new firm performance. Journal of Business Venturing 8 (3), 241–253.

Croissant, Y., Millo, G., 2008. Panel data econometrics in R: The PLM package. Journal of Statistical Software 27 (2), 1–43.

Cyert, R.M., March, J.G., 1963. A Behavioral Theory of the Firm. Prentice-Hall, Englewood Cliffs, NJ.

Delmar, F., Wennberg, K., 2007. Risk taking, aspiration levels and the evolution of new ventures. Frontiers of Entrepreneurship Research 27 (13), 1–15.
DiMaggio, P.J., Powell, W.W., 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. American Sociological Review 48 (2), 147–160.
Dutta, S., Zbaracki, M.J., Bergen, M., 2003. Pricing process as a capability: a resource-based perspective. Strategic Management Journal 24 (7), 615–630.
Dutton, J.E., Dukerich, J.M., 1991. Keeping An Eye on the Mirror: Image and Identity In Organizational Adaptation. Academy of Management Journal 34 (3), 517–554.
Edelman, L.F., Brush, C.G., Manolova, T.S., Greene, P.G., 2010. Start-up Motivations and Growth Intentions of Minority Nascent Entrepreneurs. Journal of Small Business Management 48 (2), 174–196.
Epple, D., Argote, L., Devadas, R., 1991. Organizational Learning Curves: A Method for Investigating Intra-Plant Transfer of Knowledge Acquired Through Learning by Doing. Organization Science 2 (1), 58–70.
Festinger, L., 1954. A Theory of Social Comparison Processes. Human Relations 7 (2), 117–140.
Forbes, D.P., 2005. The Effects of Strategic Decision Making on Entrepreneurial Self-Efficacy. Entrepreneurship Theory and Practice 29 (5), 599–626.
Ford, J.D., 1985. The Effects of Causal Attributions on Decision Makers' Responses to Performance Downturns. Academy of Management Review 10 (4), 770–786.
Gabor, A., Granger, C. W. J., 1966. Price as an Indicator of Quality: Report on an Enquiry. Economica 33 (129), 43–70.
Garvin, D.A., 1984. What does “product quality” really mean?. Sloan Management Review 26 (1), 25–43.
Gatewood, E.J., Shaver, K.G., Powers, J.B., Gartner, W.B., 2002. Entrepreneurial Expectancy, Task Effort, and Performance. Entrepreneurship Theory and Practice 27 (2), 187–206.
Gavetti, G., Greve, H.R., Levinthal, D.A., Ocasio, W., 2012. The Behavioral Theory of the Firm: Assessment and Prospects. Academy of Management Annals 6 (1), 1–40.
Gentry, R.J., Shen, W., 2013. The impacts of performance relative to analyst forecasts and analyst coverage on firm R&D intensity. Strategic Management Journal 34 (1), 121–130.
Giachetti, C., Lampel, J., 2010. Keeping both eyes on the competition: Strategic adjustment to multiple targets in the UK mobile phone industry. Strategic Organization 8 (4), 347–376.
Gooding, R.Z., Goel, S., Wiseman, R.M., 1996. Fixed versus variable reference points in the risk-return relationship. Journal of Economic Behavior & Organization 29 (2), 331–350.
Greve, H.R., 1998. Performance, Aspirations, and Risky Organizational Change. Administrative Science Quarterly 43 (1), 58–86.
Greve, H.R., 1999. The Effect of Core Change on Performance: Inertia and Regression toward the Mean. Administrative Science Quarterly 44 (3), 590–614.
Greve, H.R., 2003a. A Behavioral Theory of R&D Expenditures and Innovations: Evidence from Shipbuilding. Academy of Management Journal 46 (6), 685–702.
Greve, H.R., 2003b. Investment and the behavioral theory of the firm: evidence from shipbuilding. Industrial and Corporate Change 12 (5), 1051–1076.
Greve, H.R., 2003c. Organizational learning from performance feedback: A behavioral perspective on innovation and change. Cambridge University Press, Cambridge.
Greve, H.R., 2007. 'Exploration and exploitation in product innovation'. Industrial and Corporate Change 16 (5), 945–975.
Greve, H.R., 2008. A Behavioral Theory of Firm Growth: Sequential Attention to Size and Performance Goals. Academy of Management Journal 51 (3), 476–494.

Haleblian, J., Rajagoplan, N., 2006. The influence of acquisition experience and performance on acquisition behavior: Evidence from the US commercial banking industry. Academy of Management Journal 49 (2), 357–370.
Harris, J., Bromiley, P., 2007. Incentives to Cheat: The Influence of Executive Compensation and Firm Performance on Financial Misrepresentation. Organization Science 18 (3), 350–367.
Hu, S., Blettner, D., Bettis, R.A., 2011. Adaptive aspirations: performance consequences of risk preferences at extremes and alternative reference groups. Strategic Management Journal 32 (13), 1426–1436.
Ingenbleek, P., Debruyne, M., Frambach, R.T., Verhallen, Theo M. M., 2003. Successful New Product Pricing Practices: A Contingency Approach. Marketing Letters 14 (4), 289–305.
Iyer, D.N., Miller, K.D., 2008. Performance Feedback, Slack, and the Timing of Acquisitions. Academy of Management Journal 51 (4), 808–822.
Jackson, J.R., 1959. Learning from Experience in Business Decision Games. California Management Review 1 (2), 92–107.
Kahn, J.A., 1987. Inventories and the Volatility of Production. American Economic Review 77 (4), 667–679.
Kahneman, D., Tversky, A., 1979. Prospect Theory: An Analysis of Decision under Risk. Econometrica 47 (2), 263–292.
Kaplan, S., Henderson, R., 2005. Inertia and Incentives: Bridging Organizational Economics and Organizational Theory. Organization Science 16 (5), 509–521.
Ketchen, D.J., Palmer, T.B., 1999. Strategic Responses to Poor Organizational Performance: A Test of Competing Perspectives. Journal of Management 25 (5), 683–706.
Keys, B., 1986. Improving Management Development Through Simulation Gaming. Journal of Management Development 5 (2), 41–50.
Keys, B., 1988. Management Education and Development: Current Issues and Emerging Trends. Journal of Management 14 (2), 205–229.
Keys, B., 1990. The Role of Management Games and Simulations in Education and Research. Journal of Management 16 (2), 307–336.
Knudsen, T., 2008. Reference groups and variable risk strategies. A Retrospective Look at A Behavioral Theory of the Firm 66 (1), 22–36.
Krasnikov, A., Jayachandran, S., 2008. The Relative Impact of Marketing, Research-and-Development, and Operations Capabilities on Firm Performance. Journal of Marketing 72 (4), 1–11.
Kruglanski, A.W., 1975. The human subject in the psychology experiment: Fact and artifact, in: Berkowitz, L. (Ed), Advances in Experimental Social Psychology., Vol. 8, Academic Press, pp. 101–147.
Labianca, G., Fairbank, J.F., Andrevski, G., Parzen, M., 2009. Striving toward the future: aspiration--performance discrepancies and planned organizational change. Strategic Organization 7 (4), 433–466.
Lancioni, R.A., 2005. A strategic approach to industrial product pricing: The pricing plan. Pricing Issues in Industrial Marketing 34 (2), 177–183.
Lavie, D., Stettner, U., Tushman, M.L., 2010. Exploration and Exploitation Within and Across Organizations. The Academy of Management Annals 4 (1), 109–155.
Leland, H.E., 1972. Theory of the Firm Facing Uncertain Demand. American Economic Review 62 (3), 278–291.
Levinthal, D., March, J.G., 1981. A model of adaptive organizational search. Journal of Economic Behavior & Organization 2 (4), 307–333.
Levinthal, D.A., March, J.G., 1993. The myopia of learning. Strategic Management Journal 14 (S2), 95–112.

Lewis, M.A., Maylor, H.R., 2007. Game playing and operations management education. International Journal of Production Economics 105 (1), 134–149.
March, J.G., 1991. Exploration and Exploitation in Organizational Learning. Organization Science 2 (1), 71–87.
March, J.G., Shapira, Z., 1992. Variable risk preferences and the focus of attention. Psychological Review 99 (1), 172–183.
Massini, S., Lewin, A.Y., Greve, H.R., 2005. Innovators and imitators: Organizational reference groups and adoption of organizational routines. Research Policy 34 (10), 1550–1569.
McConnell, J. Douglas, 1968. An Experimental Examination of the Price-Quality Relationship. The Journal of Business 41 (4), 439–444.
McDonald, M.L., Westphal, J.D., 2003. Getting by with the Advice of Their Friends: CEOs' Advice Networks and Firms' Strategic Responses to Poor Performance. Administrative Science Quarterly 48 (1), 1–32.
McGee, J.E., Peterson, M., Mueller, S.L., Sequeira, J.M., 2009. Entrepreneurial Self-Efficacy: Refining the Measure. Entrepreneurship Theory and Practice 33 (4), 965–988.
Mezias, S.J., 1988. Aspiration level effects: An empirical investigation. Journal of Economic Behavior & Organization 10 (4), 389–400.
Miller, C.T., 1982. The role of performance-related similarity in social comparison of abilities: A test of the related attributes hypothesis. Journal of Experimental Social Psychology 18 (6), 513–523.
Miller, K.D., Chen, W.-R., 2004. Variable organizational risk preferences: Tests of the March-Shapira model. Academy of Management Journal 47 (1), 105–115.
Milliken, F.J., Lant, T.K., 1991. The effect of an organization's recent performance history on strategic persistence and change: The role of managerial interpretations, in: Dutton, J., Huff, A., Shrivastava, P. (Eds), Advances in Strategic Management. JAI Press, Greenwich, CT, pp. 125–152.
Mills, D.E., 1984. Demand Fluctuations and Endogenous Firm Flexibility. Journal of Industrial Economics 33 (1), 55–71.
Mishina, Y., Dykes, B.J., Block, E.S., Pollock, T.G., 2010. Why "Good" Firms do Bad Things: The Effects of High Aspirations, High Expectations, and Prominence on the Incidence of Corporate Illegality. Academy of Management Journal 53 (4), 701–722.
Murphy, G.B., Trailer, J.W., Hill, R.C., 1996. Measuring performance in entrepreneurship research. Journal of Business Research 36 (1), 15–23.
Nisbett, R.E., Ross, L., 1980. Human inference: Strategies and shortcomings of social judgment. Prentice-Hall, Englewood Cliffs, N.J.
Ocasio, W., 1997. Towards an attention-based view of the firm. Strategic Management Journal 18 (S1), 187–206.
O'Reilly, C.A., Tushman, M.L., 2004. The Ambidextrous Organization. Harvard Business Review 82 (4), 74–81.
Pasin, F., Giroux, H., 2011. The impact of a simulation game on operations management education. Computers & Education 57 (1), 1240–1254.
Pindyck, R.S., 1982. Adjustment Costs, Uncertainty, and the Behavior of the Firm. American Economic Review 72 (3), 415.
Porter, M.E., 1991. Towards a dynamic theory of strategy. Strategic Management Journal 12 (S2), 95–117.
Raisch, S., Birkinshaw, J., 2008. Organizational Ambidexterity: Antecedents, Outcomes, and Moderators. Journal of Management 34 (3), 375–409.
Rao, A.R., Bergen, M.E., Davis, S., 2000. How to Fight a Price War. Harvard Business Review 78 (2), 107–116.

Rhee, M., 2009. Does Reputation Contribute to Reducing Organizational Errors? A Learning Approach. Journal of Management Studies 46 (4), 676–703.
Richard, P.J., Devinney, T.M., Yip, G.S., Johnson, G., 2009. Measuring Organizational Performance: Towards Methodological Best Practice. Journal of Management 35 (3), 718–804.
Riesz, P.C., 1979. Price-Quality Correlations for Packaged Food Products. Journal of Consumer Affairs 13 (2), 236–247.
Salas, E., Wildman, J.L., Piccolo, R.F., 2009. Using Simulation-Based Training to Enhance Management Education. Academy of Management Learning & Education 8 (4), 559–573.
Saviotti, P.P., Metcalfe, J.S., 1984. A theoretical approach to the construction of technological output indicators. Research Policy 13 (3), 141–151.
Schneider, S.L., 1992. Framing and conflict: Aspiration level contingency, the status quo, and current theories of risky choice. Journal of Experimental Psychology: Learning, Memory, and Cognition 18 (5), 1040–1057.
Singh, J.V., 1986. Performance, slack, and risk taking in organizational decision making. Academy of Management Journal 29 (3), 562–585.
Slevin, D.P., 1971. The Innovation Boundary: A Specific Model and some Empirical Results. Administrative Science Quarterly 16 (4), 515–532.
Stevens, C.K., 2011. Questions to consider when selecting student samples. Journal of Supply Chain Management 47 (3), 19–21.
van Rijnsoever, F.J., Meeus, Marius T. H., Donders, A. Rogier T., 2012. The effects of economic status and recent experience on innovative behavior under environmental variability: An experimental approach. Research Policy 41 (5), 833–847.
van Rijnsoever, F.J., van Prooijen, I., van Alphen, K., 2014. Using Organizational Learning to assess micro-incentives of the Triple Helix, DRUID Society Conference 2014, Copenhagen, Denmark, 2014.
Vissa, B., Greve, H.R., Chen, W.-R., 2010. Business Group Affiliation and Firm Search Behavior in India: Responsiveness and Focus of Attention. Organization Science 21 (3), 696–712.
Washburn, M., Bromiley, P., 2012. Comparing Aspiration Models: The Role of Selective Attention. Journal of Management Studies 49 (5), 896–917.
Wells, R.A., 1990. Management Games and Simulations in Management Development: An Introduction. Journal of Management Development 9 (2), 4–6.
Wennberg, K., Holmquist, C., 2008. Problemistic search and international entrepreneurship. European Management Review 26 (6), 441–454.
Wiklund, J., Shepherd, D., 2003. Aspiring for, and Achieving Growth: The Moderating Role of Resources and Opportunities. Journal of Management Studies 40 (8), 1919–1941.
Wiklund, J., Shepherd, D., 2005. Entrepreneurial orientation and small business performance: a configurational approach. Journal of Business Venturing 20 (1), 71–91.
Wiseman, R.M., Bromiley, P., 1996. Toward a Model of Risk in Declining Organizations: An Empirical Examination of Risk, Performance and Decline. Organization Science 7 (5), 524–543.
Wood, J.V., 1989. Theory and research concerning social comparisons of personal attributes. Psychological Bulletin 106 (2), 231–248.
Zyda, M., 2005. From visual simulation to virtual reality to games. Computer 38 (9), 25–32.

FIGURES

FIGURE 1: Screen shot of machine purchase decision in the game (first round)

FIGURE 2: Screen shot of the production and price-setting decisions in the game

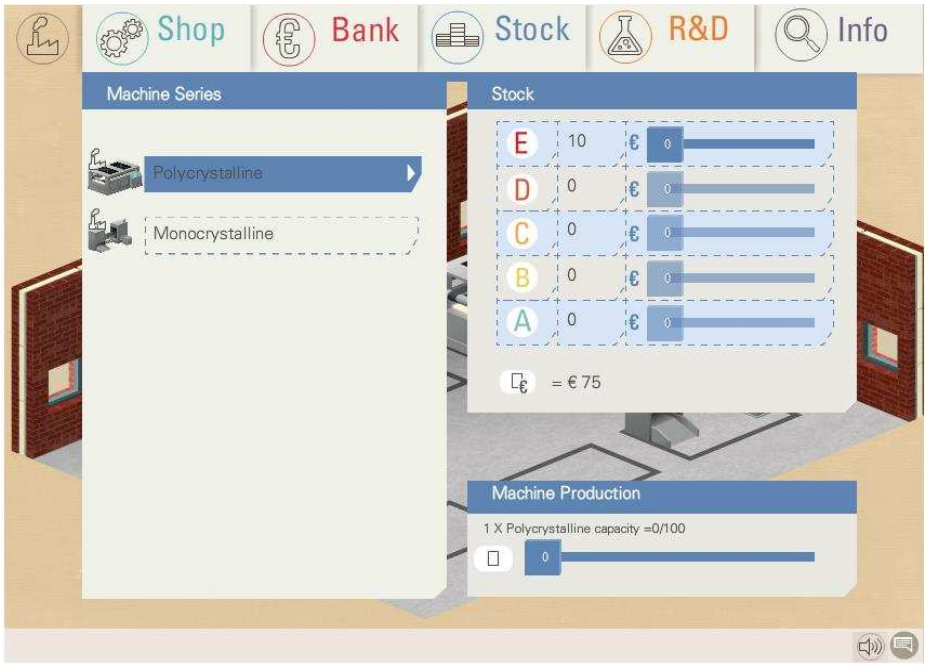

FIGURE 3: Screen shot of the R&D investment decision in the game

TABLES

TABLE 1: Machine types

Name	**Polycrystalline**	**Monocrystalline**
Production quality per panel	75 kWh/m^2/y	150 kWh/m^2/y
Production quantity per machine per quarter	100	100
Production cost per panel	75 €	150 €

TABLE 2: Overview variables and correlation matrix

		Mean	Standard deviation	Produced	Product R&D	Price	Financial slack	Products sold	Quality level	Products sold change	Financial performance change	Success Product R&D	Quality level difference	Financial performance difference
Dependent variables	Produced	8,14	5,34											
	Product R&D	6,04	8,46	0,07										
	Price	0,17	0,16	0,44	0,03									
Control variables	Financial slack	93,92	46,86	0,27	0,05	0,23								
	Products sold	12,90	16,34	0,56	0,05	0,4	0,31							
	Quality level	2,69	1,33	0,35	-0,15	0,29	-0,14	0,39						
Historical aspirations	Products sold change	-1,31	18,58	-0,09	-0,1	-0,03	-0,1	-0,6	0,02					
	Financial slack change	4,19	18,98	-0,18	0,16	-0,18	-0,27	-0,77	-0,25	0,59				
	Success Product R&D	0,25	0,43	0,09	0,16	0	-0,02	-0,05	0,18	0,03	0,26			
Social aspirations	Quality level difference	0,01	0,85	-0,13	0,05	-0,21	0,07	-0,16	-0,53	0	0,07	0,15		
	Financial slack difference	1,18	50,77	-0,25	-0,01	-0,18	-0,67	-0,33	-0,02	0,07	0,28	0,04	-0,06	
	Price difference	0	0,10	-0,16	-0,01	-0,1	-0,16	-0,47	-0,18	0,36	0,41	0,06	0,27	0,09

TABLE 3: Panel regression results

		Produced				R&D Investments				Sales Price			
		Monocrystalline		Polycrystalline		Monocrystalline		Polycrystalline		Monocrystalline		Polycrystalline	
Control variables	Polycrystalline machine			1.91				-16.17	***			-0.20	***
	Financial slack	0.01		-0.01	a	0.00		0.07	***	0.00	**	0.00	*
	Products sold	0.24	***	0.01		0.16	***	0.06		0.00		0.00	
	Quality level (2)	1.69	***	0.02		2.80	***	-0.05		0.01		-0.03	a
	Quality level (3)	2.96	***	-0.25		2.05	*	-0.01		0.01		-0.02	
	Quality level (4)	4.08	***	-0.13		1.02		-1.81		-0.01		0.02	
	Quality level (5)	4.84	***	-0.11		-8.03	***	4.58	**	0.06	**	-0.04	
Historical aspirations	Products sold change	0.06	***	0.01		-0.03	a	0.07	a	0.00	**	0.00	.
	Financial slack change	0.08	***	-0.04	**	0.12	***	-0.03		0.00		0.00	
	Success product R&D	0.64	*	-0.95	*	-0.70		1.78	*	0.04	***	-0.04	***
Social aspirations	Financial slack difference	0.00		-0.01		0.00		0.06	***	0.00	***	0.00	a
	Quality level difference	1.00	***	-0.47	a	-1.26	**	1.69	**	-0.05	***	0.03	***
	Price difference	0.76		2.91		1.60		3.68		-0.01		-0.04	
Respondent characteristics	ESE	0.09	a	-0.12	a	-0.32	**	0.58	***	0.00		0.00	
	Familiar with innovation	-0.28	*	0.11		0.82	**	-0.97	*	-0.01		0.01	
	Familiar with industry	0.62	***	-0.45	*	-0.82	*	0.47		0.01		-0.01	
	Owns business	0.53	**	-0.16		-0.24		0.72		0.00		0.00	
	Adj. R-squared	0,63				0,19				0,49			

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 'a' 0.1. The Monocrystalline columns show the estimators and significance levels for Monocrystalline machine owners. The estimators and significance levels in the Polycrystalline columns represent interaction effects. They show whether there is any significant difference between the indicators for Polycrystalline machines and Monocrystalline machines. The size of the respective Polycrystalline coefficient is obtained by adding up the coefficients for both Monocrystalline and Polycrystalline indicators.