Running head: Competitive Escalation

Competitive Escalation and Interventions

Sebastian Hafenbrädl

IESE Business School, Barcelona, Spain

Jan K. Woike

Max Planck Institute for Human Development, Berlin, Germany

Forthcoming at the Journal of Behavioral Decision Making

Address correspondence to:

Sebastian Hafenbrädl

Department of Managing People in Organizations

IESE Business School

Av. Pearson 21, 08034 Barcelona, Spain

shafenbraedl@iese.edu

Competitive Escalation and Interventions

Abstract (max 250 words)

Competitive escalation occurs frequently in managerial environments, when decisions create sunk costs and decision makers compete under time pressure. In a series of experiments using a minimal dollar auction paradigm, we test interventions to prevent competitive escalation. Without any intervention, most people, including experienced managers, escalate and lose money by bidding more than the price is worth (e.g., more than 10 € for 10 €). We test several interventions, in which we provide individuals with different types of experience: direct experience in structurally identical and in structurally similar situations, as well as direct experience in similarly competitive situations (lacking the escalation dimension). We also study indirect experience based on vicariously learning about the situation's consequences (experienced by others) and based on mental simulation by setting oneself a limit regarding where to exit the competition. In three experiments (N = 1229), we find that direct experience in exactly the same or a structurally similar situation allows individuals to prevent subsequent escalation, whereas direct experience in a similar situation without escalation does not. Indirect experience based on vicarious-learning successfully reduces competitive escalation, whereas a goal-setting intervention that has proven instrumental in reducing classic escalation of commitment is not effective. This pattern of variation in the effectiveness of different interventions is consistent with the theory of a cold–hot empathy gap that prevents people from anticipating how they will experience a competitive situation before entering it. As a methodological contribution, we developed a deception-free computer-player dollar-auction for online participants and a dynamic chicken game.

Keywords: dollar auction, competitive arousal, escalation of commitment, competition, sunk costs, hot-cold empathy gap, vicarious learning

Once you've put enough in, you'll go all the way till it's done, regardless of the value.
Matthew Dodds from Citigroup about the 2006 acquisition of medical-device maker Guidant after a bidding war between Johnson & Johnson and Boston Scientific[1].

Competition is found in almost all domains of life—from playful games to wars between nations—whenever at least two parties strive for scarce resources. In many regards, competition serves important societal functions, be it as an inspiring challenge to excel, a motor to innovate, or as the force that guides the invisible hand of markets (but see also Kohn, 1992). Under some circumstances, however, competitive actions can have adverse consequences for others (e.g., Hoffman, Festinger, & Lawrence, 1954; Mui, 1995; Münster, 2007; Kilduff, Galinsky, Gallo, & Reade, 2016; Kilduff & Galinsky, 2017) and for the actors themselves (e.g., Garcia, Tor, & Gonzalez, 2006; Ku, Malhotra, & Murnighan, 2005). It is therefore important to understand both the conditions under which competition becomes harmful and how decision makers can learn how to guard themselves against its destructive effects.

One form of destructive competition goes under the names of positional concerns (Solnick & Hemenway, 1998; Frank, 1999), competitive irrationality (Arnett & Hunt, 2002), or positional bias (Hill & Buss, 2006). It describes a shift in focus away from absolute payoffs toward one's relative outcomes in comparison with competitors. Winning becomes the goal, even when the personal costs of winning a prize are higher than the value of the prize itself (Malhotra, 2010). Prior research has shown that such a shift in focus toward a *desire to win* (Malhotra, 2010; Malhotra, Ku, & Murnighan, 2008) can be fueled by the 'hot' emotional state of *competitive arousal*, which is seen as 'laden with adrenalin' (Ku et al., 2005). Such competitive arousal can, for instance, be observed in auctions ("auction fever"), and prior research has shown that time pressure and perceptions of rivalry are important antecedents (Ku et al., 2005; Adam, Krämer, & Müller, 2015).

[1]Boston Scientific won the bidding war yet paid so much that its share price lost almost one third of its value—which led Fortune magazine to label the acquisition "the (second) worst deal ever" (Tully & Levenson, 2006).

In this article, we examine competition in situations where its consequences are potentially particularly severe, namely, situations prone to *escalation of commitment*, the phenomenon that decision makers who have invested in a losing course of action maintain and even increase their commitment after receiving negative feedback (Sleesman, Conlon, McNamara, & Miles, 2012; Staw, 1976, 1981, 1997). Commitment in this context means the allocation of tangible or intangible resources to a specific course of action. Escalation of commitment is observed on the micro level of individual decision makers as well as on the macro level of organizations (Arkes & Hutzel, 2000; Drummond, 1994; Guler, 2007; Gunia, Sivanathan, & Galinsky, 2009; Hsie, Tsai, & Chen, 2015; Lee, Keil, & Wong, 2015; Lehenkari, 2012; McNamara, Moon, & Bromiley, 2002) and is considered to be "one of the most robust and costly decision errors addressed in the organizational sciences" (Sleesman et al., 2012, p. 541). When competition is introduced in settings prone to escalation of commitment, a situation we refer to as *competitive escalation*, the destructive consequences of competition identified above are likely to be aggravated for two reasons: First, the motivational shift toward a desire to win makes increasing one's commitment even more attractive, as it suppresses concerns about the costs involved. Specifically, a desire to win shifts the attention from the absolute level of outcomes, which include both the prize to be gained and the costs of obtaining the prize, to the relative comparison with one's competitors, which means either winning the prize oneself or watching a competitor win the prize, regardless of the costs winning would entail. Second, once decision makers enter the visceral 'hot' state of competitive arousal, they may feel separated from their 'cold' selves by a so-called 'hot–cold empathy gap' (Loewenstein, 1996, 2000). In turn, the goals, plans, and intuitions they had in the 'cold' state may seem less relevant. In the same way as people who shop on an empty stomach tend to ignore their shopping lists and buy more than they need, competitively aroused decision makers might escalate their commitment far beyond what they deemed rational before competitive arousal.

To avoid the destructive consequences of competitive escalation, decision makers need to not only learn what they should rationally do but also to overcome such 'hot–cold' empathy gaps so that they will not abandon their rational plans once they become competitively aroused. Prior research has

established that different *types of experience* affect what and how effectively individuals learn (Gino, Argote, Miron-Spektor, & Todorova, 2010; Huber, 1991; Levitt & March, 1988). In this article, we distinguish between two types of experience: direct experience and indirect experience (in several variants). The costs of competitive escalation can be substantial, which makes failing to learn, and learning from direct experience, potentially expensive. The question of which type of experience can best help people to learn to address competitive escalation situations is therefore of both practical and economic relevance, as such situations occur frequently in the strategic and competitive environments in which managers operate (Malhotra et al., 2008). Finding cheaper and more efficient ways of learning can help organizations and society to reap the benefits of competition, without paying the costs.

How people learn to address situations that are prone to escalation of commitment and that elicit visceral 'hot' factors, such as competitive arousal, is also of theoretical interest for the literatures on competitive arousal and escalation of commitment as well as for the learning literature. Although it may be possible to study this question 'in vivo' in organizations (e.g., in acquisition bidding wars), the incidental nature and lack of controls might make this approach prone to post hoc rationalizations and conjecture. Therefore, we compare the effectiveness of different types of learning in reducing competitive escalation in a series of lab and online experiments. In so doing, we make the following contributions:

First, we illustrate the severity of the situational force of competitive escalation situations by showing how difficult it is to learn to address them without first experiencing the specific situation and suffering its adverse consequences directly. Second, we take a first step toward developing interventions capable of preparing people for situations prone to competitive escalation. Such interventions need to go beyond situational analysis and detailed action plans: "When we act under the influence of passions, they may cause us to deviate from plans laid in cooler moments" (Elster, 2000, p. 7). We find that a goal-setting strategy that has previously been found to reduce classic escalation of commitment is not effective in preventing competitive escalation. In contrast, a new intervention based on vicarious learning (Hoover, Giambatista, & Belkin, 2012; Maslach, Branzei, Rerup, & Zbaracki, 2018) succeeds in reducing escalation and could potentially be used for training modules, for instance, in management education.

The Hot–Cold Empathy Gap, Competitive Arousal, and Competitive Escalation

Visceral factors, such as hunger, thirst, pain, moods, and emotions, affect behavior differently than nonvisceral factors, such as preferences or information. First, they "tend to 'crowd out' virtually all goals other than that of mitigating the visceral factor" (Loewenstein, 1996, p. 272). Second, individuals not currently experiencing a visceral factor (i.e., in a 'cold' state) cannot fully anticipate its effect; they underestimate or completely ignore its influence. This failure to empathize with oneself or others in the 'hot' state while one is in a 'cold' state is termed the 'hot–cold empathy gap' (Loewenstein, 1996, 2000). We argue that competitive arousal is such a visceral state and that, once individuals experience it, they value winning against the competition over all other goals, consistent with the notion of a desire to win (Malhotra, 2010). Because of this qualitative change in motivation, competitive arousal has particularly harmful consequences when it occurs in situations prone to escalation of commitment (i.e., competitive escalation situations).

Whereas competition sometimes helps (e.g., Camerer, Loewenstein, & Weber, 1989) to diminish decision biases, sometimes it does not (e.g., Kühberger & Penner, 2003; Massey & Thaler, 2013; Sassenberg, Moskowitz, Jacoby, & Hansen, 2007), and in specific cases it might even exacerbate them (e.g., Radzevick & Moore, 2010). We expect situations prone to escalation of commitment to be among these latter cases. It is sometimes rational to persevere even after learning that the course of action taken did not lead to the best possible result (but, for instance, was still the best option to choose based on expectations; Zikmund-Fisher, 2004). In typical escalation of commitment situations, however, the decision maker maintains her or his commitment even after learning that the course of action taken was inferior in the first place and likely remains inferior for the future.

We conceptualize *competitive escalation* situations as being the intersection between competition on the one hand and escalation of commitment on the other; competitive escalation means that the escalation is aggravated by the 'hot' state of competitive arousal. We adopt from prior research that competitive arousal, in turn, results from the combination of time pressure and competition (Ku et al., 2005; Adam et al., 2015). Competitive escalation situations involve the decision to compete with at least

one other party over a non-sharable prize. If, after an initial decision to commit resources, a decision maker learns that another party is closer to winning the prize than the decision maker herself, then she faces a choice: either to invest more resources in an attempt to catch up with and overtake the other party or to give up and let the other party win. The resources already committed are *sunk costs*: retrospective costs that cannot be recovered and should be disregarded when making subsequent decisions (Arkes & Blumer, 1985). However, if the decision maker enters a 'hot' emotional state (of competitive arousal), she develops a desire to win against the other party and shifts her focus away from the costs that attempting to win would entail (which may be substantial given that the other party is also committed to win). The decision maker will therefore be more likely to allocate more resources—to escalate her commitment—for instance, by continuing to bid in an auction.

Various high stakes situations share specific characteristics that make them particularly prone to competitive escalation, such as that the resources contestants invest are non-refundable, regardless of whether they win the competition (Hart, Avrahami, Kareev, & Todd, 2015). For instance, in political elections, multiple parties compete for the presidency, but only one party can win. All parties need to make initial decisions to commit resources to their campaign, and then, the party that learns it was falling behind faces the decision to either intensify their campaigning, or to draw out of the race. While they should rationally ignore the already invested resources as sunk costs, it seems unlikely that they are able to overcome "one of the most robust and costly decision errors" and escalate their commitment. In the 2012 US presidential elections, for example, Barack Obama and his contender Mitt Romney both spent about $1 billion on their campaigns (Ashkenas, Ericson, Parlapiano, & Willis, 2012). Other examples for situational characteristics that enable competitive escalation can be found in mergers and acquisitions, where multiple firms typically invest in due diligence efforts when they compete to buy another company and learn that other bidders may be getting ahead. Thus, even if they do not win the bidding war (and thus do not have to pay their bid), they commit resources that turn into sunk costs in the process of placing a bid. Similar situations arise in research and development, where multiple teams invest resources in developing a new technology, but only the fastest team can file the patent.

In most of these examples, it is possible to construct rational explanations for escalation of commitment based on second-order effects. Decision makers may wish to develop a reputation of being competitive to deter future attacks (Clark & Montgomery, 1998), ensure a dominant market position for their company, to signal to others how far they are willing to go to defend their position, or to lure others into paying too much, leaving them as weaker competitors in future bouts. Yet these explanations could well be speculations or post hoc rationalizations—escalation may also occur in situations lacking such incentives for strategic behavior (e.g., managing one's reputation or weakening one's rivals). To isolate the psychological processes triggered in the situations described above, we have constructed an experimental paradigm that resembles these situations in terms of the temporal order of decisions and the payoff structure, while excluding such strategic considerations. This allows us to test whether the structural features of these situations prompt participants to engage in competitive escalation and investigate how different experiences allow individuals to subsequently avoid competitive escalation.

Our experimental paradigm is a variant of the Dollar Auction Game (Shubik, 1971; Teger, 1980), which is a special case of an all-pay auction (Hörisch & Kirchkamp, 2010) and was used in prior escalation research (e.g., Ku, 2008). In this game, a fixed sum of money (the exact value is common knowledge) is auctioned off to participants. Only the highest bidder receives the money (henceforth 'prize'), but both the highest and the second-highest bidder have to pay their respective bids. Every bidder can make or raise a bid at any time. The auction ends when a specified time period has elapsed without a new bid. This structure creates time pressure, in particular for the second-highest bidder, who is bound to lose his bid without reward. Our paradigm thus mimics the structure of resource allocation decisions in political campaigns, mergers and acquisitions, and patent races described above: Just as an actor's effort and investment becomes meaningless as soon as a competitor gets ahead, a participant's bid becomes a sunk cost as soon as another participant makes a higher bid.[2] By continuing to bid against each other, two

[2] Of course, in many naturally occurring situations such as mergers and acquisitions, the sunk costs for the second-highest bidder are typically lower than the entire bid. We chose this rather extreme case to ensure that the sunk costs were salient for our participants in the lab. We agree that, on a relative scale, the sunk costs for the second-highest bidder may be lower outside of the lab. However, on an absolute scale, the second-highest bidder faces substantial

participants enter a spiral of competitive escalation and can easily end up bidding and paying more than the prize is worth. To give an extreme example, a $20 bill was auctioned off for $2,000 in an executive MBA class of approximately 70 students (Murnighan, 2002). Bidding started with fixed $1 increments that Murnighan incrementally raised to $50 in the final stage—and bidding for the $20 bill continued.[3]

While this example illustrates how determined the competing bidders were to win, competitive escalation differs from and goes beyond the idea that people derive value solely from winning (and therefore bid more than the prize is worth; Bühren & Pleßner, 2014; Sheremeta, 2010;Van den Bos et al., 2008), that anticipated feelings create a negative value for losing ('loser's curse;' Ariely & Simonson, 2003), or that the value of the prize is overestimated ('winner's curse;' Thaler, 1988). Although individuals may value winning or not losing per se and be willing to give up or pay money to win a game, we contend that competitive escalation goes beyond competitive arousal by adding escalation of commitment. In other words, we expect to conceptually replicate the well-established effects of escalation of commitment under competitive arousal.[4] Using our dollar auction paradigm to elicit competitive escalation, we expect participants to lose more money than participants competing for the same prize in an English first-price auction, which lacks the escalation of commitment aspect. An English first-price auction is identical to the dollar auction, with the exception that the second-highest bidder does not have to pay her bid, meaning that investments do not become sunk costs. We propose the following hypothesis:

---

costs—from conducting the due diligence investigations necessary to bid for an acquisition, for example, or from the damage to reputation of losing a bidding war. To mimic these substantial costs without increasing the complexity of our experimental paradigm, we decided to define the entire bid of the second-highest bidder as sunk costs.

[3] One might suspect that at some point in the auction the participants anticipated that the "winners" would not be forced to pay the full amount bid (which is, indeed, what happened: they did not have to pay the full $2000). Therefore, one cannot rule out the possibility that the high bids are at least partly due to participants not taking the game seriously—even though they later claimed they did.

[4] A number of experimental settings used to study escalation of commitment entail some form of competition: For instance the "radar scrambling device" scenario (Arkes & Blumer, 1985; Garland & Newport, 1991; Garland, 1990) mentions a competing firm, or Ku (2008) uses a computer based dollar auction setup. These studies already demonstrate that escalation of commitment occurs in competitive situations. However, these studies do not compare the severity of the escalation in the competitive situation that is prone to escalation of commitment to a similar competitive situation that lacks the escalation aspect, which is an interesting benchmark from our perspective. Hypothesis 1 reflects our theorizing that the effect of escalation of commitment will beat this benchmark.

Hypothesis 1: Individuals face larger losses in a competitive escalation situation than in a similar competitive situation without the escalation aspect.

Learning from Different Types of Experience

How can individuals learn to address competitive escalation situations? Building on de-biasing research (Fischhoff, 1982; Milkman, Chugh, & Bazerman, 2009; Jung & Young, 2012) and de-escalation research (Doerflinger, Martiny-Huenger, & Gollwitzer, 2017; Kirby & Davis, 1998; Kwong & Wong, 2014; Nathanson et al., 1982; Simonson & Staw, 1992), one of our goals was to test to what extent people can learn to avoid competitive escalation. De-biasing competitive positional concerns is hard, even in the absence of escalation of commitment. Graf, König, Enders and Hungenberg (2012) tested five different de-biasing interventions for such situations. While 31% of their subjects in the control condition chose a "competitively irrational option", even their strongest intervention, a "training in biases" in which subjects read quotes from the Harvard Business Review about emotions and social comparisons (Malhotra et al., 2008, p. 78 and 80.), only reduced this proportion to 23% (a marginally significant effect). Instead of building on these more classical de-biasing interventions, we thus decided to explore how different types of experience allow people to learn to avoid competitive escalation. Prior research has shown that different types of learning experience result in different learning outcomes (Huber, 1991; Levitt & March, 1988). One important distinction is between learning directly from one's own experience (Haselhuhn, Pope, Schweitzer, & Fishman, 2012) and learning indirectly, either from the experience of others (Darr, Argote, & Epple, 1995; Gino et al., 2010) or from thinking about the situation and trying to mentally simulate the experience. Another distinction is between learning how to address a situation by experiencing that specific situation, and learning by transferring from the experience of other, more or less similar, situations (Argote & Ingram, 2000; Kraiger, Ford, & Salas, 1993; Szulanski, 2000).

Direct experience in exactly the same or a structurally similar task or situation ('learning by doing') should provide the most powerful learning opportunity (e.g., Argote & Todorova, 2007) and could thus serve as a benchmark. Direct experience exposes individuals to all aspects of the situation, including both 'hot' competitive escalation and its destructive consequences. Because the task in which

individuals learn and the task they encounter afterwards are identical, the conditions for knowledge transfer are ideal (Thorndike, 1913; Snapp-Childs, Wilson, & Bingham, 2015). Nevertheless, prior research has shown that after losing in a competition, people often set themselves a more challenging goal (Buser, 2016). Indeed, when Murnighan (2002) repeated his auction experiment in a classroom setting up to three times, some students continued to bid and to escalate. The extreme case we described above was actually a second auction, following one in which the winning bid for the $20 bill was $54. Murnighan's classroom setting differs in many respects from our minimal competitive escalation paradigm, however. In particular, if bidders who have just lost money in the auction learn from their experience, there are only two potential bidders left in any group of four participants. Furthermore, prior research suggests that when decision makers experience regret after escalation, they are less likely to escalate again immediately afterwards (Ku, 2008). Therefore, we propose the following hypothesis:

Hypothesis 2: Individuals with direct experience in a competitive escalation situation escalate less in subsequent competitive escalation situations than individuals without such direct experience.

Even if individuals have not experienced exactly the same task before, they can potentially transfer knowledge acquired from their experience in similar or related tasks (see Blume, Ford, Baldwin, & Huang, 2010, for a recent review of the training transfer literature). In what way two tasks need to be related so that people can transfer what they have learned from one to the other is largely an open question (e.g., Snapp-Childs et al., 2015). However, if two tasks share most features—except one—and one cannot learn from one to the other, then this demonstrates that the feature on which they differ is crucial. Ordinary competitive situations share most features—except the escalation of commitment-prone task structure—with competitive escalation situations. To investigate whether knowledge from competitive situations can be transferred to competitive escalation situations, we had participants play an English first-price auction first and our dollar auction second, using the same computer interface. Participants thus gained experience with both the auction situation and the computer interface used to enter bids. What is more, they were first exposed to competitive arousal and the auction process without the destructive consequences of competitive escalation. Because we contend that competitive escalation is

qualitatively different from competition alone, we assume that people need to experience a competitive escalation situation that includes these destructive consequences in order to learn to avoid subsequent competitive escalation. We therefore propose the following hypothesis:

Hypothesis 3: Individuals with direct experience in a competitive situation without the escalation aspect do not escalate less in a subsequent competitive escalation situation than individuals without such direct experience

One form of indirect experience is absorbing the experience of others, a process that has been termed vicarious learning (Bandura, 1977; Hoover et al., 2012; Manz & Sims, 1981). It can be especially effective in changing behavior, particularly when people learn from others' adverse outcomes or failures (Bandura, 1966, 1977; Ellison & Fudenberg, 1993, 1995; Kim & Miner, 2007; Kc, Staats, & Gino, 2013). Vicarious learning could go beyond processing the information that the situation could lead to adverse outcomes: participants who feel empathy toward those who received the adverse outcomes might also affectively experience these consequences vicariously. In a vicarious-learning intervention, we informed participants on the final payoffs received by the seven groups in the baseline condition (reported below in Experiment 1a, all but one group experienced escalation and lost money). Note that our vicarious-learning intervention does not allow participants to observe the escalation process, but only the outcomes of the specific situation they later experienced themselves (making it a conservative test of the effects of vicarious learning). Participants received this information before experiencing the auction themselves; they could therefore process the information before they made their first decision (avoiding that their chosen course of action could bias their information processing; Schulz-Hardt, Vogelgesang, Pfeiffer, Mojzisch, Thurow-Kröning, 2010), and bear it in mind when deciding whether to enter the auction or to continue bidding and escalating. Specifically, knowing that people typically lose money in this situation could shift participants' reference point for acceptable outcomes, thereby enabling them to accept small losses from initial bids and in turn to stop bidding before larger losses occur.

Hypothesis 4: Individuals with indirect experience of vicariously learning the consequences of a competitive escalation situation for others escalate less in a subsequent competitive escalation situation than individuals without such indirect experience.

Another form of indirect experience can be generated by participants themselves, by mentally simulating how a competitive escalation situation might unfold. Prompting participants to engage in this type of experience comes close to a de-escalation strategy that has been shown to significantly reduce escalation of commitment effects (Brockner, Shaw, & Rubin, 1979; Henderson, Gollwitzer & Oettingen, 2007; Simonson & Staw, 1992): a 'goal-setting' intervention based on the mental budgeting approach (Heath, 1995; Thaler, 1999). In this intervention, people are asked to think about how the situation might develop and to set a limit for their investment (i.e., for bids in the dollar auction). In our setting, we asked participants to think about how the dollar auction might unfold and to set themselves a (nonbinding) monetary limit, up to which they plan to bid and stay in the auction. As this de-escalation strategy was designed to facilitate a calculative process aimed at finding a rational point up to which it is sensible to invest, it may not be able to counter the 'hot' state of competitive arousal assumed to occur in this situation. Individuals experiencing a 'hot–cold' empathy gap (Loewenstein, 1996, 2000) cannot anticipate how their motivation will change from a focus on maximizing absolute outcomes to a desire to win. They will therefore exceed their self-imposed limit when they enter the competitive state. As the experienced situation feels qualitatively different from the situation imagined in a 'cold' state, plans and strategies devised for the imagined situation will appear to be irrelevant. We therefore propose the following alternative hypothesis:

Hypothesis 5: Individuals with indirect experience of mentally simulating how the competitive escalation situation will unfold and setting oneself an investment limit do not escalate less in a subsequent competitive escalation situation than individuals without such indirect experience.

General Method

From the Dollar Auction to the Minimal Dollar Auction Paradigm

Following the call in Prentice and Miller (1992) to create minimal conditions for studying effects in controlled environments, we sought to develop a dollar auction paradigm that was as close to minimal as possible. A first advantage is that such conditions reduce the number of potential confounds and eliminate alternative explanations. This allows researchers to make more precise causal attributions and to differentiate between (competing) theoretical explanations, thereby increasing internal validity. A second advantage is that a minimal paradigm increases external validity: In some studies, features are added to bolster the strength of an effect, but these features are often not part of the environment in which the effect naturally occurs. In a minimal paradigm, such features are removed. Third, using a minimal paradigm allows us to gauge the robustness of the phenomenon under investigation: A phenomenon that can be observed with only a small number of preconditions is more robust than one that requires more conditions to be met. The $2000 bid for a $20 bill is impressive, but the setting of Murnighan's (2002) class auction was not minimal. Several features of it, which might not necessarily be present in organizational settings, may have amplified the escalation or may limit the generalizability of findings: a large crowd of spectators (Beeler & Hunton, 1997), identifiability of and familiarity between players (Haran & Ritov, 2014), the outgoing and active atmosphere of the classroom game, and rules for possible increments in bid sizes.

In our minimal dollar auction paradigm, participants played a variant of the dollar auction in which a fixed amount of money (in Experiment 1: CHF 10, approximately USD 10.50 or 9 EUR at the time of the study, in Experiment 2 and 3: 0.50 USD, 0.42 EUR at the time of the study) were auctioned off to the highest bidder, and both the highest and the second-highest bidder had to pay their respective bids. We propose that competition is destructive if the winner, the highest bidder in the auction, loses money. The game was played in small groups of four (in the laboratory) or two (in the online setting) participants in a quiet setting without spectators and with guaranteed anonymity. Furthermore, we relaxed the rules on minimum and maximum increments for bidding, allowing all bids larger than the current bid

(that were multiples of CHF 0.25 (approximately USD 0.26 or 0.22 EUR) in Experiment 1 or multiples of 0.02 USD in Experiment 2 and 3).

In contrast to actors in organizational contexts, participants in laboratory settings have limited opportunities to learn about the task or the structure of the environment. We therefore ensured that every participant correctly understood the workings of the minimal dollar auction before it began. Detailed experimental instructions explained every step of the auction process, and participants had to pass a comprehension check before being allowed to take part in the auction. In all experiments, sample sizes were determined in advance. We report all studies we conducted in this line of research.

Experiment 1a: Learning from Direct Experience (Students)

The primary purpose of Experiment 1a was to test Hypotheses 1–3. Specifically, we tested whether the amount bid in the minimal dollar auction paradigm exceeded the amount bid in an English first-price auction (H1). In addition, we examined whether providing people with the opportunity to gain direct experience in a competitive escalation situation (H2) and in a competitive situation that lacked the escalation aspect (H3) can serve as an intervention, preparing participants to avoid competitive escalation and the resulting losses in a subsequent competitive escalation situation.

Method

Participants. We used the online recruitment system ORSEE (Greiner, 2015) to recruit 56 students (20 female and 36 male; mean age: 21.4 years) from a large participant pool at two large Swiss universities. The experiment took place in a computer lab, where blinds between computers ensured that participants could see only their own screen. The experiment was embedded in a 90-minute session comprising various economic games and questionnaires with performance-contingent payments. We report all measures and manipulations that are relevant for this study; no participants were excluded. Sample size was determined before any data analysis. The computer interface was specifically programmed for this experiment. Participants' expected (average) reimbursement was approximately CHF 38.00 (approximately 40 USD / 35 EUR) for the entire session, which was in line with the typical

hourly rate in this lab. Participants could potentially lose all money earned, except for a minimum payment of CHF 3.00 (approximately 2.85 USD or 2.60 EUR). It can therefore be assumed that, up to the expected total earnings, they perceived the potential losses in the minimal dollar-auction as consequential. Participants were randomly assigned to groups of four, with between two and four groups taking part per session.

Procedure. Participants were randomly assigned to two between-subjects conditions: in the 'first-price auction' condition, they played a first-price auction and then the dollar auction; in the 'repeated dollar auction' condition, they played the dollar auction twice. Participants were first familiarized with the rules and details of the interface. The instructions for the first-price auction emphasized that only the highest bidder would have to pay his bid and would receive the prize of CHF 10.00. The instructions for the dollar auction emphasized that both the highest bidder and the second-highest bidder would have to pay their respective bids, but that only the highest bidder would receive the CHF 10.00. Participants had to correctly answer several questions checking their understanding of the task and the interface before entering the auction.

Participants placed bids by entering their desired bid size, either directly through an input box or through two sets of buttons (corresponding to CHF 0.25 and CHF 0.50 step-size increases and decreases). Bids were made by pressing a 'submit' button. The minimum possible bid was CHF 0.25 above the current highest bid. There was no maximum bid enforced. All players were immediately informed about bids by other players, and minimum bid amounts were adjusted after each new bid. A decreasing timer bar indicated the time remaining for new bids and was refilled after each new bid. The auction ended when the timer reached zero. Participants were informed that the speed of the timer bar could increase over the course of the auction.[5]

After finishing the first auction, participants were informed about the second auction: Participants in the 'first-price auction' condition were introduced to the dollar auction and answered the corresponding

[5] The speed of the timer bar started to increase only when a (very high) threshold for a bid value was reached.

control questions. Participants in the ‘repeated dollar auction’ condition were shown only a summary of the auction’s rules.

Results

INSERT TABLE 1 ABOUT HERE

Table 1 summarizes means, medians, and standard deviations for the highest and second-highest bids across experimental conditions. Because of the relatively small number of independent observations and because these variables were not normally distributed, we used nonparametric statistical tests. When playing the dollar auction as first auction, 86% of participants placed a bid at some point in the auction, and 39% placed a bid higher than CHF 10.00. In six of the seven groups, the highest bid surpassed CHF 10.00. Thus, the minimal dollar auction paradigm was sufficient to elicit competitive escalation. Even the winners of the auction lost on average CHF 4.64.

Participants who played a first-price auction before the dollar auction had lower highest bids (Mann–Whitney U-test: $U = 7.50$, $n_1 = n_2 = 7$, exact $p = .026$, two-tailed, $r = 0.58$) and lower second-highest bids ($U = 7.00$, $n_1 = n_2 = 7$, exact $p = .026$, two-tailed, $r = 0.60$) in that auction, although two participants escalated even in the first-price auction, overbidding the prize by CHF 0.50 and CHF 0.25, respectively. Thus, we found support for Hypothesis 1: Participants bid less and therefore lost less money in the first-price auction than in the dollar auction, illustrating that our minimal dollar auction paradigm was sufficient to elicit competitive escalation. Figure 1 illustrates how the bidding unfolded in the dollar auction paradigm. In particular, it shows how the two highest bidders surpassed the value of the prize of CHF 10.00 in small increments, with both ending up paying more than CHF 20.00.

INSERT FIGURE 1 ABOUT HERE

Participants who played the dollar auction a second time engaged in less competitive escalation: Although 79% of them placed a bid at some point in the second auction, the highest bid (not the second-highest bid) now surpassed CHF 10.00 in only one of the seven groups. Relative to the first dollar

auction, there was a significant difference in both highest bids (Wilcoxon signed-rank test: $n = 7$, $z = -2.03$, exact $p = .043$, two-tailed, $r = 0.77$) and second-highest bids ($n = 7$, $z = -2.03$, exact $p = .042$, two-tailed, $r = 0.77$). Participants on average won CHF 0.71. Thus, we found support for Hypothesis 2: Participants did not bid more than CHF 10.00 in the second dollar auction. Experiencing a competitive escalation situation worked as an intervention and enabled individuals to avoid the destructive consequences of a subsequent escalation situation

In contrast, when playing the first-price auction before, 89% of participants placed a bid at some point in the dollar auction, and 36% placed a bid higher than CHF 10.00. In five of the seven groups, the highest bid surpassed CHF 10.00. We found no significant difference in highest bids ($U = 24.00$, $n_1 = n_2 = 7$, exact $p = 1$, two-tailed, $r = 0.02$) or second-highest bids ($U = 22.50$, $n_1 = n_2 = 7$, exact $p = .805$, two-tailed, $r = 0.07$) between participants who played the first-price auction before playing the dollar auction and participants who played the dollar auction first. Thus, we found support for Hypothesis 3: Even after participants had played a first-price auction, they still escalated their bidding in the minimal dollar auction paradigm.

Experiment 1b: Learning from Direct Experience (Executives)

Because research on competitive escalation should ultimately inform managers and policy makers, it is important to test the research paradigms with samples of participants who are as similar as possible to the population of decision makers to which we want to generalize. The purpose of Experiment 1b was thus to underline the external validity of the paradigm by replicating some of the results from Experiment 1a with experienced executives, who are typically embedded in competitive environments (Malhotra et al., 2008; Garcia & Tor, 2007). Prior research provided evidence that the level of managerial training is related to decreased tendencies for escalating commitment outside of competitive situations (Fennema & Perkins, 2008). Testing how competitive escalation unfolds in a sample of actual managers is thus an important precondition to generalize any results to the population of such managers.

Method

Participants. The experiment was run in the context of a course on negotiation and decision making in the executive MBA program of a large Swiss university, attended by 29 executives (5 female and 24 male; mean age: 38.1 years). The managers had at least 7 years of professional experience, 63% had more than 10 years, and 30% had more than 14 years of experience. The experiment was embedded in a 50-minute session comprising various other games and questionnaires with performance-contingent payments. We report all measures and manipulations that are relevant for this study; no participants were excluded. Sample size was determined before any data analysis. Participants' expected (average) reimbursement for the entire session was approximately CHF 22.00.

Procedure. For the dollar auction, participants were randomly assigned to groups of four (leaving one manager, who had to assume the role of an observer), and these seven groups were tested simultaneously. The procedure was identical to that for Experiment 1a, except that all participants played the dollar auction twice (none played a first-price auction). The experiment took place in four computer labs reserved for the class, and participants were distributed over the labs to make sure that players could not see the screens of other group members.

Results

INSERT TABLE 2 ABOUT HERE

Table 2 summarizes means, medians, and standard deviations for the highest and second-highest bids across experimental conditions. Approximately 82% of participants placed at least one bid, and 39% of participants (in four of the seven groups) placed a bid higher than CHF 10.00. Thus, we found that competitive escalation occurs frequently even in a sample of experienced executives, replicating the results of Experiment 1a. While comparisons across different samples should be interpreted with caution, the results of the executive sample and the previously observed student sample playing the dollar auction as first auction did not differ notably: we found no significant difference in highest bids (U = 25.00, n_1=

n_2= 7, exact p = 1, two-tailed, r = 0.02) or second-highest bids (U = 25.00, n_1= n_2= 7, exact p = 1, two-tailed, r = 0.02). On average, participants lost CHF 5.07.

Like the students in Experiment 1a, executives who played the dollar auction a second time engaged less in competitive escalation: 75% of them placed a bid at some point in the second auction, which was not significantly fewer than in the first dollar auction (z = −.65, p = .51), but only 18% of participants (in three of the seven groups) overbid the prize. There was a significant difference in highest bids (n = 7, z = −2.03, p = .043, two-tailed, r = 0.77) and second-highest bids (n = 7, z = −2.21, p = .027, two-tailed, r = 0.83) between the first and the second auction. Participants on average lost CHF 1.18.

In sum, the level of competitive escalation among experienced executives was similar to the level we found among students in Experiment 1a. This underlines the paradigm's external validity and bolsters our confidence in generalizing our results to executives.

Experiment 1c: Learning from Indirect Experience

The purpose of Experiment 1c was to test Hypotheses 4 and 5. In particular, we investigated whether individuals could learn to address competitive escalation situations from two types of indirect experience: vicarious learning and mental simulation of the situation using a 'goal-setting' intervention.

Method

Participants. We recruited 56 students (23 female and 33 male; mean age 21 years) at a large Swiss university from the same participant pool as in Experiment 1a. The experiment was again embedded in a 90-minute session comprising various economic games and questionnaires, with an expected total reimbursement of about CHF 38.00 and a guaranteed minimum payment of CHF 3.00. We report all measures and manipulations that are relevant for this study, no participants were excluded. Sample size was determined before any data analysis.

Procedure. Participants were randomly assigned to one of two treatment conditions: goal setting and vicarious learning. With the exception of these interventions, the procedure in Experiment 1c was the same as in Experiment 1a. Participants first learned the rules of the auction and were introduced to the interface. After a comprehension check, they were presented with the condition-specific intervention.

In the goal-setting condition, participants were asked to imagine the course of the auction and to set a limit: the maximum amount they were willing to bid. The limit was prominently displayed during the auction but not automatically enforced. As soon as a participant exceeded his limit, it was highlighted in red and a warning was shown below it.

In the vicarious-learning condition, participants were presented with the auction results for the seven groups in Experiment 1a. In particular, they were informed that the mean highest bid for these groups was CHF 13.00 and that the mean second-highest bid was CHF 11.25. In addition, they saw a detailed table containing the highest, second-highest, and third-highest bids, as well as the corresponding payoffs for the highest, second-highest, and third-highest bidders. Only one of these bidders had a positive payoff. To ensure that participants read and understood this information, we required them to answer several control questions correctly before beginning the auction. Participants in the vicarious-learning condition played a second auction immediately after the first. The purpose of this second auction was to investigate whether first-hand learning had an additional effect on escalatory behavior above and beyond vicarious learning. There was no second auction in the goal-setting condition.

Results

Table 3 summarizes means, medians, and standard deviations for the highest and second-highest bids across experimental conditions.

INSERT TABLE 3 ABOUT HERE

Vicarious learning. In the vicarious-learning condition, 82% of participants placed a bid at some point in the auction, but only 7% of participants (in one of the seven groups) placed a bid higher than CHF 10.00. The percentage of participants placing a bid was not significantly lower than in the dollar auction without intervention in Experiment 1a ($z = 0.36$, $p = .72$). Comparison with the first dollar auction reported in Experiment 1a revealed a significant difference in highest bids ($U = 3.50$, $n_1 = n_2 = 7$, exact $p = .004$, two-tailed, $r = 0.72$) and in second-highest bids ($U = 4.00$, $n_1 = n_2 = 7$, exact $p = .007$, two-tailed, $r = 0.70$). Participants in the vicarious-learning condition on average lost CHF 0.94. However, the winners

of the auction on average won CHF 2.89. Thus, we found support for Hypothesis 4: Competitive escalation was reduced by presenting participants with the outcomes of previously participating groups.

When playing the auction a second time (without repetition of the vicarious-learning manipulation), 71% of participants in the vicarious-learning condition placed a bid at some point in the auction. This was not significantly different from when playing the auction the first time in the vicarious-learning condition ($z = .95$, $p = .34$). However, the highest bid did not surpass CHF 10.00 in any of the seven groups. We found a significant difference in highest bids ($n = 7$, $z = -2.02$, $p = .043$, two-tailed, $r = 0.76$) and second-highest bids ($n = 7$, $z = -2.37$, $p = .018$, two-tailed, $r = 0.89$) between the first and the second auction. Participants on average won CHF 1.10.

We found no significant difference between the results for the second dollar auctions in the vicarious-learning treatment and in Experiment 1a, in either highest ($U = 13.00$, $n_1 = n_2 = 7$, exact $p = .165$, two-tailed, $r = 0.40$) or second-highest bids ($U = 15.00$, $n_1 = n_2 = 7$, exact $p = .259$, two-tailed, $r = 0.33$). Participants in the second dollar auction after the vicarious-learning intervention won on average CHF 0.30 more than participants in the second dollar auction in Experiment 1a.

Goal setting. Of the 28 participants in the goal-setting condition, 24 set themselves a limit of CHF 10.00 or below; the remaining 4 participants (14%) set themselves a higher limit. However, 11 of the 28 players (39%) bid more than their limit. In the goal-setting condition, 82% of participants placed a bid at some point in the auction. This percentage of participants was not significantly different from that observed in the dollar auction without intervention in Experiment 1a ($z = .36$, $p = .72$). Approximately one third (32%) of the participants (in five of the seven groups) placed a bid higher than CHF 10.00. Participants on average lost CHF 12.04.[6]

Comparing the highest and second-highest bids with those observed in the first dollar auction with the student sample in Experiment 1a revealed no significant differences (highest bids: $U = 25.50$,

[6] The more extreme results were driven by an outlier: One of the auctions escalated up to a highest bid of CHF 111.00. Excluding that auction, the mean highest bid was CHF 16.42 (*SD* = CHF 14.94), and the median was CHF 11.50. The mean second-highest bid was CHF 14.42 (*SD* = CHF 16.00) and the median was CHF 10.50. Participants still lost CHF 4.81 on average, and even the winners of the auction lost CHF 6.41 on average.

$n_1 = n_2 = 7$, exact $p = .90$, two-tailed, $r = 0.03$; second-highest bids: $U = 25.00$, $n_1 = n_2 = 7$, exact $p = 1$, two-tailed, $r = 0.02$). Thus, we found support for Hypothesis 5: Competitive escalation did occur in the minimal dollar auction paradigm, even when participants set themselves a limit before entering the auction.

Discussion Experiment 1

In Experiment 1 we demonstrated that our minimal dollar auction paradigm was sufficient to elicit competitive escalation, and we found initial support for Hypotheses 1-5. These results are consistent with our theorizing about the 'hot-cold' empathy gap: the vicarious-learning intervention succeeded at reducing competitive escalation. We propose that it provided participants with a reason not to enter the 'hot' state and the escalatory spiral in the first place. Although vicarious learning helped to reduce escalation in the dollar auction, having experienced the dollar auction at first hand reduced escalation even further. Learning from both the vicarious-learning intervention *and* from experience of the dollar auction did not have a stronger effect than first-hand learning (from experiencing the dollar auction) alone. This finding is in line with recent evidence from the effects of different types of experience on investment decisions: Lejarraga, Woike and Hertwig (2016) showed that experience in investing in funds allows for a different kind of learning than analyzing the fund's past performance without investing.

In contrast to the vicarious learning intervention, and in addition, consistent with the literature on 'hot–cold' empathy gaps, the goal-setting intervention, which has previously succeeded in averting escalation of commitment (Heath, 1995; Simonson & Staw, 1992), did not prevent competitive escalation in the minimal dollar auction paradigm. In fact, escalation was at least as strong—and potentially even stronger—for participants who set themselves a limit before the auction. It is possible that setting a limit in fact gave participants a reason to continue beyond their initial bids: Because a limit is set, the auction seems less dangerous, and it may appear more rational to continue bidding. Once engaged in the auction and having passed the stage of introductory bids, participants entered the 'hot' state, which they could not anticipate when setting their limit in the 'cold' state, and they thus failed to respect their own limit.

Experiment 2: Testing the Minimal Dollar Auction Paradigm in an Online Setting, and Unpacking the Goal Setting Intervention

The main purpose of Experiment 2 was to adapt and test our minimal dollar auction paradigm in an online setting. Observing competitive escalation among online participants would provide additional evidence for the robustness of the phenomenon. At the same time, the online setting significantly reduces the monetary costs for each observation (allowing for future research with larger sample sizes): We auctioned off USD 0.50. The second purpose of Experiment 2 was to unpack the *goal setting* intervention. Specifically, we differentiated between the indirect experience of merely mentally simulating how the competitive escalation situation might unfold (without setting oneself a limit) and setting oneself a limit (which of course similarly requires to mentally simulate how the auction might unfold). Moreover, we intended to test whether we can increase the effectiveness of the mental simulation by prompting participants to think about the key stage in the competitive escalation process, in which one party is forced to either drop out or to bid more than the value of the prize. Specifically, we prompted them to imagine that they bid 48 cents for a price of 50 cents in the dollar auction paradigm and that their opponent, in turn, bid 50 cents, and asked them what they would do in this situation (see Open Materials for more details). This new intervention was specifically designed to examine the potential concern that the dollar auction is a mere "parlor trick", which only works because people do not anticipate the possibility that the winner of the auction can lose money. Players make bids of 50 cents to avoid a certain loss of 46 cents (in reaction to a counterbid of 48 cents) and no player can win money from this critical bid on. Subscribers to the "dollar auction is a parlor trick" idea typically believe that if only people considered and understood this crucial moment before the game, they would not lose money in the auction. Our intervention puts this idea to a direct test by confronting participants with the critical stage in the auction process.

Method

Participants. We recruited 193 US based participants (79 male, 114 female; mean age 36 years) from Amazon's Mechanical Turk (MTurk). This experiment was embedded in a longer collection of

tasks. We report all measures and manipulations that are relevant for this study; no participants were excluded[7].

Procedure. We set up Experiment 2 as an online study to allow for larger sample sizes. For feasibility reasons, we adapted our minimal dollar auction paradigm such that each participant plays against a computer player that is programmed based on the behavior of earlier participants[8]. We made this fully transparent to participants, the experiment did not involve any deception. Playing against simulated others serves a conservative test for competitive escalation, as one could argue that simulated others inspire less rivalry than non-simulated others, so if we nevertheless observe competitive escalation, this underlines the phenomenon's robustness. All participants were endowed with a bonus of USD 1.20 when entering the task, which they could potentially lose. We auctioned off USD 0.50. Participants placed bids by clicking on one of 5 buttons, which increased the currently highest bid by 2, 4, 6, 8 or 10 cents, respectively.

Participants were randomly assigned to one of four conditions: *baseline*, *goal setting*, *mental simulation of the escalation in general*, and *mental simulation of the escalation point*. As in Experiment 1, participants were first familiarized with the rules and details of the interface. In the *goal setting* condition, participants were asked to state the maximum amount they were willing to bid for the 50 cents price in the dollar auction, while the instructions emphasized that this limit would not be enforced but that participants should keep it in mind. In the *mental simulation of the escalation in general* condition,

[7] In the beginning of this larger collection of tasks, some participants were excluded because they failed attention checks or due to double participation. Once participants entered the auction task, they were assigned to conditions, and none of these participants were excluded. Another group of participants also responded to a variant of the dynamic chicken game we introduce in Experiment 3. Due to technical problems and unusually high attrition rate in this condition (many participants skipped this time-consuming condition, as it was framed as voluntary, and skipping the task did not affect participants' fixed and bonus payment for the rest of the experiment), their results became uninterpretable, and we will not report them here. However, all results would be fully consistent with our theorizing and the results of Experiment 3, which do not suffer from these problems.

[8] Participants were made aware that the computer player's responses are modeled after the behavior of earlier participants. The computer player was bidding in 2 cent increments until the bidding reached 54 cents, and then continued in 4 cents increments until the bidding reached 110 cents. At this point the computer player would drop out. In the rare situation that the participant would not make any bid for 18 seconds upon starting the auction, the computer would make a bid of 1 cent.

participants were asked to think about how the auction unfolds and write a short description. In the *mental simulation of the escalation point* condition, participants were asked to imagine that they bid 48 cents and the other player reacted by bidding 50 cents. They were asked to either indicate that they would bid more than 52 cents, would bid 52 cents but then stop, or stop now and pay the 48 cents.

Results

INSERT TABLE 4 ABOUT HERE

Table 4 summarizes means, medians, and standard deviations for the highest bids across the different conditions[9], as well as the percentage of participants who placed a bid at all, who placed a bid above 50 cents, and the percentage of participants who "won" the auction (the simulated player stopped bidding after 110 cents)[10].

Participants in the baseline condition bid significantly more than 50 cents for the price of 50 cents (M = 64.6, SEM = 4.96, $t(49)$ = 2.95, p = .005). This validates the online version of the dollar auction paradigm. Supporting H5, participants with indirect experience of mentally simulating how the competitive escalation situation would unfold and setting themselves a limit (goal-setting condition) did not escalate significantly less in a subsequent competitive escalation situation (M = 55.5, SEM = 5.05) than participants without such an indirect experience ($t(89)$ = 1.27, p = .21, d = 0.27). While they bid slightly (but not significantly) less, a majority of limit setters bid beyond their limit (73%), and 39% bid

[9] See Appendix for a full regression table.

[10] Experiment 2 was also used as an opportunity to explore the affective nature of the situation, and, to the extent that this is possible using a retrospective self-report measure, to bolster the assumption that competitive escalation is indeed driven by competitive arousal. To do so, we asked participants how they had felt during the game immediately after the first auction. Participants responded on a five-point scale to 20 items of the PANAS (Watson, Clark & Tellegen, 1988). While participants were explicitly asked to report their affect during the situation, we can of course not exclude the possibility that the payoff they received could spill over into their reported affect, such that high bids, which imply high losses, would result in negative affect (examples for negative affect items are: distressed, upset, irritable and jittery). Thus, while such a spillover account would predict a correlation between losses and negative affect, finding evidence for a correlation between escalation (high bids) and positive affect (examples for positive affect items are: excited, strong, enthusiastic and determined) would be suggestive of the association between competitive escalation and arousal. We first aggregated both the negative affect items and the positive affect items from the PANAS into a scale (Cronbach's alpha was .82 and .86, respectively), and then regressed them on participant's highest bid, while controlling for the experimental condition. The analysis reveals a significant relationship between positive affect and the size of the highest bid (B = 6.96, SE = 2.65, p = .009), while the relationship between negative affect and the size of the highest bid does not reach statistical significance (B = 4.71, SE = 3.24, p = .148).

beyond 50 cents. A post hoc power analysis revealed that we would need a larger sample of *N*= 200 per condition to detect an effect of this size with adequate power and an alpha of 0.05 (i.e., our a priori power estimation for this new paradigm was too optimistic). We test this hypothesis in Experiment 3 with adequate power. Mentally simulating the escalation in general (without limit setting) and mentally simulating the key escalation point yielded similar, if not worse results (see Table 4).

Discussion

In Experiment 2, we successfully adapted our minimal dollar auction paradigm to an online setting and were able to instill competitive escalation in MTurk participants, when each participant was bidding one-to-one against a computer player. We also found additional evidence supporting H5: indirect experience through mental simulation and setting oneself a limit does not prevent subsequent competitive escalation. Our results furthermore illustrate that it does not matter much whether the mental simulation is combined with the goal setting instructions or not, or whether participants are explicitly prompted to think about the escalation point at which the auction turns into a game in which both players lose money. By prompting participants to think about this escalation point, we could rule out the concern that the dollar auction is a mere "parlor trick" that, once people think about it, nobody would fall for.

Experiment 3: Replicating and Extending the Main Results with a Larger Sample

The main purpose of Experiment 3 was to replicate our results from Experiment 1 with a larger sample and to extend them in several ways. First, we intended to extend H1 by showing that a competitive escalation situation led to larger losses than a similar competitive situation without the escalation aspect– regardless of whether people win or lose money in this first escalation situation. Second, we intended to expand upon H2, showing that direct experience in a competitive escalation situation subsequently reduces competitive escalation even in a different, but structurally similar, escalation situation. Third, we intended to replicate H3 by showing that direct experience in a competitive situation without the escalation aspect does not reduce escalation in a subsequent competitive escalation situation. Fourth, we intended to replicate H4, showing that the indirect experience of vicariously learning the consequences of a competitive escalation situation for others reduces subsequent competitive escalation. Fifth, we intended

to replicate H5, showing that the indirect experience of mentally simulating how the competitive escalation situation will unfold, and setting oneself a limit does not reduce competitive escalation.

Method

Participants. We recruited 1,001 US-based participants (56.1% female; mean age of 35 years) from Amazon's Mechanical Turk. This experiment was embedded in a longer collection of tasks. We report all measures and manipulations that are relevant for this study; no participants were excluded at the data analysis stage (before they could enter the study, we automatically excluded people who participated in Experiment 2 and participants with an IP address that was already used by another participant, as well as people from outside the US).

Procedure. We set up Experiment 3 as an online study to allow for larger sample sizes, using the paradigm we developed in Experiment 2. All participants were endowed with a bonus of USD 1.20 when entering the task, which they could potentially lose. We auctioned off 50 cents. Participants placed bids by clicking on one of five buttons, which increased the currently highest bid by 2, 4, 6, 8 or 10 cents, respectively.

In addition to the dollar auction, we developed a second, structurally similar competitive escalation situation: a *dynamic chicken game*. As in the dollar auction, the winner in this game received 50 cents. In contrast to the dollar auction, both participants automatically and simultaneously increased their bid by 5 cents for every 5 seconds they stayed in the game. They could stop bidding by stepping out of the game at any time, achieved by clicking on the only available button on the page. The player who remained in the game longer won the 50 cents. This dynamic chicken game is structurally similar to the dollar auction, once one considers the cost of staying in the game as a bid for the money. In both games the highest and the second highest bidder have to pay their respective bid, while only the highest bidder receives the prize. The only difference is that in the dynamic chicken game, participants automatically place a bid in every time period in which they do not actively end the game, whereas in the dollar auction participants automatically ended the game when they did not actively place a bid. When we tested H2 in Experiment 1, we examined the effect of direct experience in a competitive escalation situation on

participants' subsequent behavior in exactly the same competitive escalation situation. As a more powerful test, in Experiment 3, we investigate the effect of direct experience in a competitive escalation situation on participants' subsequent behavior in a different, but structurally similar competitive escalation situation, the dynamic chicken game. Specifically, participants in the baseline condition played this dynamic chicken game after they had finished the dollar auction. We compare their escalation behavior to participants in another condition, who only played the dynamic chicken game.

Participants were randomly assigned to one of five conditions: *baseline (followed by the dynamic chicken game), first-price auction, vicarious learning, goal setting,* and *dynamic chicken game only*. As in Experiments 1 and 2, participants were first familiarized with the rules and details of the interface. In the *baseline* condition, participants first played the dollar auction. After finishing the dollar auction (in the baseline condition), they were informed that they would receive an additional bonus to refill their bonus account (unless their bonus account still contained the full USD 1.20), so that they would start the dynamic chicken game with exactly USD 1.20 (without this additional bonus, participants who escalated and thus lost money in the dollar auction might have had less money left to lose). Having less bonus money left could potentially add a confound in testing H2, as experience in the first competitive escalation situation would reduce people's bonus, and thus making them potentially more conservative afterwards. By resetting the bonus amount (to the participant's unexpected advantage), we avoid any such income effects. If anything, we could see a "house-money effect", in which people would gamble more with the additional bonus, which would make it harder for us to find support for H2.

In the *first-price auction* condition, participants first played a first-price auction for 50 cents against a computer player and afterwards played a dollar auction for 50 cents. To explore to what extent participant's behavior in the dollar auction depends on whether they won the prize in the first-prize auction, participants were randomly assigned to a computer player that bid either until 46 cents or until 50 cents (of course participants could stop bidding before that point in both conditions)[11]. In the *vicarious*

[11] As both bidding strategies corresponded to the behavior of a sizable percentage of participants in Experiment 1, this could be implemented without deception.

learning condition, participants were presented with the auction results of participants in the baseline condition of Experiment 2. In particular, they were informed about the results of the 100 players in Experiment 2 (50 MTurk participants and 50 computer players). Specifically, they were informed how many of these players won or lost money after playing their bids, and about the mean financial results for the highest and second-highest bidders (see the Open Materials for details). In the *goal setting* condition, participants were asked to state the maximum amount they were willing to bid for the 50 cents price in the dollar auction, while the instructions emphasized that this limit would not be enforced but that participants should keep it in mind. In the *dynamic chicken game only* condition, participants played only the dynamic chicken game.

Results

INSERT TABLE 5 ABOUT HERE

INSERT FIGURE 2 ABOUT HERE

Table 5 summarizes means, medians, and standard deviations for the highest bids across the different conditions[12], as well as the percentage of participants who placed a bid at all, who placed a bid above 50 cents, and the percentage of participants who "won" the auction (the simulated player escalated until 110 cents)[13]. Figure 2a depicts the distributions of bids in the different conditions, and Figure 2b displays the cumulative probability of staying in the auction as a function of bid size.

What first stands out is that across all conditions, we see less escalation than in Experiment 1 and Experiment 2. For instance, in the baseline condition, the average highest bid is 42.2 cents, and thus significantly below the price of 50 cents ($t(194)$ = 3.32, p = .001, d = 0.48). Nevertheless, 95% of the

[12] See Appendix for a full regression table.

[13] In Experiment 3, we aimed at replicating the association between positive affect and escalation we found in Experiment 2. Immediately after the first auction, participants responded about how they had felt during the game to 20 items of the PANAS (Watson, Clark & Tellegen, 1988). We again found a positive association between affect levels and the size of participants' bids. We again aggregated items into a positive and a negative scale (Cronbach's alpha is .90 and .91, respectively), and then regressed them on participants' highest bids, while controlling for the experimental condition. Both positive affect (B = 7.74, SEM = 1.37, p < .001) and—to a weaker degree—negative affect (B = 3.99, SEM = 1.62, p = .01) are significantly associated with higher bids.

participants in this condition lost money, on average 36.5 cents, illustrating that there is still potential for the interventions to prevent losses. While we expected competitive escalation to be weaker when playing against computer players on the Internet than against other people in the lab, it is harder to make sense of the differences between Experiment 2 and Experiment 3. One potential explanation would be that the auction in Experiment 2 was embedded in a longer battery of other tasks so that the bonus money participants could potentially lose made up a smaller percentage of their total earnings from the battery of tasks. In contrast, Experiment 3 was shorter, potentially making the additional bonus to be perceived as more important for their overall earnings, and thereby making participants more cautious to risk it in the auction game. As our main focus was whether the different interventions help reducing competitive escalation, we were more interested in the relative differences between conditions than in the absolute level of escalation in the paradigm. Therefore, let us turn now to testing our hypotheses.

Supporting H1, participants faced significantly larger losses in the competitive escalation situation (M = -36.5, SEM = 1.66) than in a similar situation without the escalation aspect, where the average result is slightly positive (M = 0.6, SEM = 0.08, $t(194.9)$ = 22.03, $p < .001$, d = 2.27). The difference in highest bids, however, is not statistically significant (dollar auction: M = 42.15, SEM = 2.27, first-price auction: M = 37.7, SEM = 1, Welch's $t(262.1)$ = 1.73, p = .08, d = 0.18) and should be interpreted carefully: When the computer player bid until 46 cents, participants bid less (but not significantly less) than when the computer player bid until 50 cents, illustrating that this result is somewhat influenced by the strategy of the computer player.

Supporting H2, participants with direct experience in a competitive escalation situation escalated less in a subsequent competitive escalation situation (highest bid in the dynamic chicken game: M = 43.5, SEM = 3.06 in the *baseline* condition, and M = 60.7, SEM = 2.71 in the *chicken game only* condition, $t(394)$ = 4.20, $p < .001$, d = 0.42). Supporting H3, participants with direct experience in a competitive escalation situation without the escalation aspect did not escalate less in a subsequent competitive escalation situation (M = 54.4, SEM = 2.81) than participants without such an experience—rather they escalated more (baseline: M = 42.2, SEM = 2.81, $t(401)$ = 3.32, p = .001, d = 0.33). In particular,

participants who played the first-price auction against a computer who stopped bidding at 46 cents drive this result, as they were bidding significantly more (M = 59.9, SEM = 3.7) than participants who played the first-price auction against a computer player who stopped bidding at 50 cents (M = 48.8, SEM = 4.2, $t(206)$ = 1.99, p = .048, d = 0.27). Even in this case, we can reject the hypothesis that direct experience in a competitive situation without the escalation aspect would reduce escalation by one cent or more (p = .04, following the TOST procedure, Lakens, 2017).

Supporting H4, participants with indirect experience of vicariously learning the consequences of a competitive escalation situation escalated less (M = 34.0, SEM = 2.29) in a subsequent competitive escalation situation than other participants without such indirect experience ($t(393)$ = 2.47, p = .01, d = 0.24). Supporting H5, participants who mentally simulated how the competitive escalation situation would unfold and set themselves a limit did not escalate significantly less in a subsequent competitive escalation situation (M = 43, SEM = 2.42) than participants without such an indirect experience ($t(389)$ = 0.25, p = .80, d = 0.03). While we cannot reject the hypothesis that limit setting could have reduced competitive escalation by one cent (p = .29), equivalence testing following the TOST procedure revealed that we can reject the hypothesis that it reduced competitive escalation by five cents or more (p = .04). A majority (61%) of limit setters bid beyond their limit.

Finally, our data also allows us to analyze whether there were any gender differences in competitive escalation: When we regress participants' highest bid on a dummy variable that equals 1 for women and 0 otherwise (and exclude the one person that answered the gender question with "other"), while controlling for experimental condition, we find no evidence for gender differences (B = 1.61, SE = 2.00, p = .42). This null-result is robust against alternative specifications, for instance when including an interaction of gender with experimental conditions.

Discussion

In Experiment 3, we successfully replicated our results from Experiments 1 and 2, and thereby strengthened the support for our hypotheses, while ruling out potential concerns about small sample sizes and limited statistical power. One observation we want to highlight is that in the *vicarious learning*

condition, there is (almost) a gap between those bidders who stop at approximately 50 cents and those who bid all the way up to 110 cents (where they might only stop because they win the auction) – almost nobody stops bidding in between. If this intervention works particularly well for one type of participants, for those who would at some point be willing to let go and accept their losses, and not so much for another type of participants, those who are going to stick it out until the end, this could be an interesting starting point for future research that aims to tailor interventions to "behavioral types" for whom they might work most effectively.

General Discussion

In our experiments, experienced managers, students and MTurk participants consistently engaged in competitive escalation: They literally ended up paying more than CHF 10.00 for CHF 10.00 or USD 0.50 for USD 0.50. We demonstrated that competitive escalation can arise when time pressure and rivalry—situational features associated with competitive arousal—coincide with a payoff structure prone to escalating commitment. This effect goes beyond what can be explained by the value individuals might assign to winning per se (Sheremeta, 2010; Van den Bos et al., 2008), and it cannot be attributed to unfamiliarity with the auction situation or the computer interface. Table 6 summarizes the various interventions we tested and their effectiveness in reducing competitive escalation. Participants were able to learn not to engage in escalatory behavior from direct experience in exactly the same or a structurally similar task, but not from direct experience in a similar task that lacked the escalation aspect. We also tested the effects of two types of indirect experience: Vicariously learning about others' outcomes in the same situation was effective in reducing competitive escalation. In contrast, mentally simulating the escalation point, at which one player bids the value of the prize, did not reduce competitive escalation – the dollar auction is not a mere "parlor trick". Furthermore, mentally simulating the experience in combination with (or without) setting a limit—an intervention that resembles a 'goal-setting' intervention known to prevent classical escalation of commitment—had no effect on competitive escalation.

INSERT TABLE 6 ABOUT HERE

Theoretical and Practical Implications

Our work on competitive escalation casts further light on the emotional aspects of organizational decision making, as called for in prior research (e.g., Bazerman, Tenbrunsel, & Wade-Benzoni, 1998; Walsh, 1995). Specifically, our interventions allowed us to test whether competitive escalation situations are particularly challenging because of a 'hot–cold' empathy gap (Loewenstein, 1996, 2000). If competitive escalation were not driven by a 'hot' state of competitive arousal, then a 'goal-setting' intervention known to prevent classical escalation of commitment (Simonson & Staw, 1992) should have been effective. However, consistent with the 'hot–cold' empathy gap, we found that participants did not anticipate how they would feel once the escalation started. Having entered the 'hot' state, they ignored the goal they had set themselves in a 'cold' state. This is consistent with a 'restraint bias' proposed by Nordgren, Van Harreveld, and Van Der Pligt (2009): Individuals who feel in control of their impulses, a feeling that could arise once they have set themselves a goal, tend to overexpose themselves to temptation. Once the temptation takes effect and they become aroused, they feel different from their own past self who set a goal in the 'cold' state and thus no longer feel committed to their goal. This process unfolds because participants do not anticipate entering a 'hot' state. Competitive arousal might not only catch individuals unaware, it may also be hard to make sense of and be prone to misattribution (Schachter & Singer, 1962). In many negotiation situations, a positive interpretation of arousal may be useful and improve individual performance (Brown & Curhan, 2013), while a negative interpretation leads to poorer outcomes (Brooks & Schweitzer, 2011). In competitive escalation situations, in contrast, a negative interpretation of arousal may be beneficial: It gives participants a reason not to enter the escalatory spiral. Vicarious learning seems to facilitate such a negative interpretation of arousal, because it clearly demonstrates the negative outcomes of other people in the same situation. Participants informed in this way are then willing to accept small losses from early bids. The vicarious-learning intervention gives individuals a justification to stop, an exit option that does not evoke a feeling of missing out or losing. Relative to the participants in Experiment 1a or Experiment 2, whose results they had observed, they

could still feel like winners. Indeed, feelings arising from a mere contemplation of losses have been linked to overbidding in social competition (Delgado, Schotter, Ozbay, & Phelps, 2008).

Interestingly, similar numbers of people in each experiment made at least one bid. Thus, vicarious learning does not affect whether or not people enter the auction in the first place, but it does affect whether they continue to engage in the escalation process. The observed escalation is consistent with the suggestion that motivations shift not (only) toward relative comparison and a desire to win exogenously because of relational (Kilduff et al., 2016; Piezunka, Lee, Haynes, & Bothner, 2018) or structural features of the situation (Garcia, Tor, & Schiff, 2013) but also endogenously as the competition unfolds 'naturally' (Malhotra, 2010). Our findings suggest that competitive arousal involves not only a shift toward giving absolute payoffs less weight and relative standing more weight but also a qualitative shift toward a 'hot' aroused state that calls for countermeasures other than a rational reassessment of one's goals (see also Sheldon & Fishbach, 2011, for their analysis of competition as a self-control problem). As Nobel laureate Thomas Schelling asks: "If I am too enraged to mind my behavior, how can I make myself count to ten?" (Schelling, 2006, p. 90).

The inherent problem of taking rational measures to counteract an irrational state of mind is nicely illustrated by Elster's example from Homer 's Odyssey (Elster, 2000): Ulysses and all his men knew that it was essential to keep a certain distance from the Sirens' island and that coming closer would result in their untimely death. Anticipating that their unspoken commitment to steer clear of the island would waver in the face of temptation, he ordered his men to tie him to the mast and to put beeswax in their ears before being exposed to the Sirens' call. Thus, he acknowledged the futility of limits set in the absence of temptation and learned from the unfortunate examples of earlier vessels and their crews. In the present research, we showed that these insights apply not only to ship captains in mythological Ancient Greece but also to contemporary managers. We add competition to the list of visceral 'hot' states—hunger, pain, fear, addiction, gambling, and sexual arousal—that are difficult for people in a 'cold' state to anticipate. Policy makers aiming to design institutions that can profit from competition and the

associated efficiency gains without suffering its harmful effects should be aware of how this 'hot–cold' empathy gap affects competitive escalation.

In our experiments, competition among bidders, time pressure, and sunk costs were sufficient to elicit competitive escalation. Similar conditions are found in many high-stakes situations faced by managers, such as patent wars, mergers and acquisitions, and arms races, to the extent that decision makers are also driven by factors beyond rational and strategic considerations in such naturally occurring situations. Accordingly, researchers trying to understand these settings should not neglect the motivational consequences of competitive escalation and the 'hot–cold' empathy gap. We believe that our micro level findings have implications for macro perspectives in the research field of competitive dynamics (Chen & Miller, 2012; Hsieh, Tsai, & Chen, 2015). Competitive escalation could be a driver of competitive aggressiveness (Ferrier, 2001) and play a role in explaining red queen competition (Derfus, Maggitti, Grimm, & Smith, 2008). Aiming to bridge the micro and macro levels and to allow both research streams to cross-fertilize each other, competitive escalation could potentially be integrated in the awareness-motivation-capability (AMC) framework (Chen, 1996; Chen, Kuo-Hsien, & Tsai, 2007).

While vicarious learning is not limited to competitive escalation situations, it is particularly useful for competitive situations, which are known to reduce search and exploration during the situation itself (Phillips, Hertwig, Kareev, & Avrahami, 2014). Moreover, it is particularly useful for situations that are prone to destructive consequences– situations in which direct experience would be very costly. At the same time, it is more challenging for organizations and individuals to learn from failure (Dahlin, Chuang, & Roulet, 2017). For instance, people often focus on successful others and ignore selection processes that could have eliminated unsuccessful others from the considered population, which likely leads to misleading conclusions: Among the observed survivors, competitive and risky behavior appears related to performance, but those players who acted in similarly competitive and risky ways and did not survive are not visible (Denrell, 2003). Instead of trying to learn from particularly successful others, others who are particularly similar to oneself, or even from one's own history (March, Sproull, & Tamuz, 1991), our vicarious learning intervention focused on others who faced a similar situation. Granted, it will be harder

to compile such a group of others in naturally occurring situations—outside of an experimental paradigm. At the same time, our results illustrate how well vicarious learning from others who faced a similar situation could serve as the basis for an intervention—which could be used in management education and training. In this sense, vicarious learning might be able to bridge the gap between description and experience (Hertwig, Barron, Weber, & Erev, 2004; Hertwig, Hogarth, & Lejarraga, 2018) by confronting learners with outcomes experienced by others in addition to reading the description of the game.

Methodological considerations

In this paper, we combine lab and online experimentation, and we believe much can be gained by this strategy of first establishing a phenomenon in the lab where participants play against other participants for higher stakes and then moving to an online setting in which sample sizes can be scaled up to ensure that the earlier results are not spurious and solely based on sampling variation. The use of "computer players", who are programmed to resemble laboratory participants and, thereby, enable both tightly controlled and deception-free interactions, proved to be a valuable tool and can be recommended for future experimenters. That participants engaged in similarly competitive behavior both against other human participants in the lab and computer players online highlights what can be done in Internet experiments without large technical effort and without deception (see Arechar, Gächter, & Molleman, 2018, for a more general discussion of conducting interactive online experiments).

Another methodological contribution of this paper is the development of a novel task in Experiment 3, the dynamic chicken game. This game allowed us to test whether people could transfer what they learned in one competitive escalation situation, the dollar auction, to a structurally similar situation, the dynamic chicken game. We find strong support for this hypothesis and hope the dynamic chicken game can serve future investigators as an interesting paradigm to study competitive escalation, and, for instance, to test learning from dollar auction experiences and interventions (for example, how long such learning effects last).

Limitations and Future Directions

Several limitations of the present research should be noted. Although we based our predictions on prior research on 'hot–cold' empathy gaps and competitive arousal, we collected only behavioral and self-report data and no physiological measures. Yet, participants' self-reported affect, which significantly correlates with the degree of escalation, and participants' post-experiment comments strongly support our theorizing that 'hot' competitive arousal is driving the escalation. For instance, one participant wrote, "The rise of excitement made me lose my sense of the game"; others stated, "It is horrible to let oneself get carried away", or "It destabilized me and made me lose control over the game" and even "stress, neither method nor order to arrive at things, an urge to always bid more to win the auction"[14] (see Supplementary Materials for a larger selection of comments from participants of Experiment 3). Nevertheless, future research could dig deeper into the underlying process by showing how (physiological) arousal develops when the first bids are made and how this 'hot' state can change the focus from absolute gains to beating other players, thus fueling escalation. Another avenue for future research would be to explore how long the learning effects last and how they might be refreshed.

We investigated competitive arousal in individual decision making. In contrast to many organizational settings, our decision makers were neither embedded in a group or hierarchy nor accountable to others for their decisions. Although this approach allowed us to develop and test a minimal paradigm, future research could add and manipulate some of these variables. For instance, will groups engage in stronger competitive escalation than individuals because of groupthink (Choi & Kim, 1999; Janis, 1972) or spreading of competitive arousal through emotional contagion (Barsade, 2002)? Or will groups act more rationally than individuals (White, Hafenbrädl, Hoffrage, Reisen, & Woike, 2011)? Will vicarious learning also work on the group level as a de-escalation strategy? The proposed paradigm can be easily adapted to have groups making bidding decisions together, allowing these and related questions to be studied in future research.

[14] Translated from French from participants in Experiment 1

Managers could benefit from training in effective ways of addressing emotions (Shepherd, 2004) and, more specifically, as we have shown, emotions resulting from competitive escalation situations. Identifying which type of experience can best help people learn to avoid competitive escalation is a first step, but future research could design and validate interventions specifically for organizational contexts. Such methods could be included in executive education and MBA curricula. In particular, as we have shown that the auction is not a mere "parlor trick" that becomes trivial once you think about the escalation point in which the game changes, future research could focus more deeply on how the auction can be used as an educational intervention. It could not only aim at measuring spillover effects from playing the auction, such as on behavior in the dynamic chicken game that we have shown in Experiment 3 but also focus on real-life behavioral changes. Another avenue for future research is to further explore the potential of vicarious learning to prepare executives for competitive escalation situations. For instance, could instructors in MBA classrooms provide detailed examples of competitive escalation processes in organizations and illustrate their consequences, and would this equip students to avoid competitive escalation in their future careers? Or could the students themselves share their experiences, thereby creating opportunities for vicarious learning? Future research could also look into questions such as how vicarious learning opportunities in the classroom can be designed and structured to be most effective.

Conclusion

Managers are frequently exposed to competitive escalation situations, such as patent races, bidding wars for corporate mergers, or arms races between rival companies. The proposed minimal dollar auction paradigm reliably recreates such situations in the laboratory and online. This shows how easily competitive escalation can be elicited and highlights the need for effective de-escalation strategies. By connecting the literature on competitive arousal with the theory on 'hot–cold' empathy gaps and the learning literature, we have shown that competitive escalation is fundamentally different from escalation of commitment and thus calls for different countermeasures: a goal-setting strategy effective in reducing escalation of commitment has no effect in competitive escalation situations. However, consistent with theoretical predictions, a vicarious-learning intervention succeeds in reducing competitive escalation.

References

Adam, M. T., Krämer, J., & Müller, M. B. (2015). Auction fever! How time pressure and social competition affect bidders' arousal and bids in retail auctions. *Journal of Retailing*, *91*(3), 468–485. http://dx.doi.org/10.1016/j.jretai.2015.01.003

Arechar, A. A., Gächter, S., & Molleman, L. (2018). Conducting interactive experiments online. *Experimental Economics*, *21*(1), 99–131. https://doi.org/10.1007/s10683-017-9527-2

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, *82*(1), 150–169. http://dx.doi.org/10.1006/obhd.2000.2893

Argote, L., & Todorova, G. (2007). Organizational learning. *International Review of Industrial and Organizational Psychology*, *22*, 193–234. http://dx.doi.org/10.1002/9780470753378.ch5

Ariely, D., & Simonson, I. (2003). Buying, bidding, playing, or competing? Value assessment and decision dynamics in online auctions. *Journal of Consumer Psychology*, *13*(1), 113–123. http://dx.doi.org/10.1207/153276603768344834

Arkes, H. R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes*, *35*(1), 124–140. http://dx.doi.org/10.1016/0749-5978(85)90049-4

Arkes, H. R., & Hutzel, L. (2000). The role of probability of success estimates in the sunk cost effect. *Journal of Behavioral Decision Making*, *13*(3), 295–306. https://doi.org/10.1002/1099-0771(200007/09)13:3<295::AID-BDM353>3.0.CO;2-6

Arnett, D. B., & Hunt, S. D. (2002). Competitive irrationality: The influence of moral philosophy. *Business Ethics Quarterly*, *12*(3), 279–303. https://doi.org/10.2307/3858018

Ashkenas, J., Ericson, M., Parlapiano, A., & Willis, D. (2012). The 2012 money race: Compare the candidates [Interactive infographic]. Retrieved January 4, 2017, from http://elections.nytimes.com/2012/campaign-finance

Bandura, A. (1966). Vicarious processes: A case of no-trial learning. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology, Vol. 2* (pp. 1–55). New York, NY: Academic Press.

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice-Hall.

Barsade, S. G. (2002). The ripple effect: Emotional contagion and its influence on group behavior. *Administrative Science Quarterly*, *47*(4), 644–675. http://dx.doi.org/10.2307/3094912

Bazerman, M. H., Tenbrunsel, A. E., & Wade-Benzoni, K. (1998). Negotiating with yourself and losing: Making decisions with competing internal preferences. *Academy of Management Review*, *23*(2), 225–241. http://dx.doi.org/10.5465/amr.1998.533224

Beeler, J. D., & Hunton, J. E. (1997). The influence of compensation method and disclosure level on information search strategy and escalation of commitment. *Journal of Behavioral Decision Making*, *10*(2), 77–91. https://doi.org/10.1002/(SICI)1099-0771(199706)10:2<77::AID-BDM248>3.0.CO;2-5

Blume, B. D., Ford, J. K., Baldwin, T. T., & Huang, J. L. (2010). Transfer of training: A meta-analytic review. *Journal of Management*, *36*(4), 1065–1105. http://dx.doi.org/10.1177/0149206309352880

Brockner, J., Shaw, M. C., & Rubin, J. Z. (1979). Factors affecting withdrawal from an escalating conflict: Quitting before it's too late. *Journal of Experimental Social Psychology*, *15*(5), 492–503. https://doi.org/10.1016/0022-1031(79)90011-8

Brooks, A. W., & Schweitzer, M. E. (2011). Can nervous Nelly negotiate? How anxiety causes negotiators to make low first offers, exit early, and earn less profit. *Organizational Behavior and Human Decision Processes*, *115*(1), 43–54. http://dx.doi.org/10.1016/j.obhdp.2011.01.008

Brown, A. D., & Curhan, J. R. (2013). The polarizing effect of arousal on negotiation. *Psychological Science*, *24*(10), 1928–1935. http://dx.doi.org/10.1177/0956797613480796

Bühren, C., & Pleßner, M. (2014). The Trophy Effect. *Journal of Behavioral Decision Making*, *27*(4), 363–377. https://doi.org/10.1002/bdm.1812

Buser, T. (2016). The impact of losing in a competition on the willingness to seek further challenges. *Management Science*, *62*(12), 3439–3449. https://doi.org/10.1287/mnsc.2015.2321

Camerer, C., Loewenstein, G., & Weber, M. (1989). The curse of knowledge in economic settings: An experimental analysis. *Journal of Political Economy*, *97*(5), 1232–1254. http://dx.doi.org/10.1086/261651

Chen, M.-J. (1996). Competitor analysis and interfirm rivalry: Toward a theoretical integration. *Academy of Management Review*, *21*(1), 100–134. http://dx.doi.org/10.5465/amr.1996.9602161567

Chen, M.-J., Kuo-Hsien, S., & Tsai, W. (2007). Competitive tension: The awareness-motivation-capability perspective. *Academy of Management Journal*, *50*(1), 101–118. http://dx.doi.org/10.5465/amr.1996.9602161567

Chen, M.-J., & Miller, D. (2012). Competitive dynamics: Themes, trends, and a prospective research platform. *The Academy of Management Annals*, *6*(1), 135–210. http://dx.doi.org/10.1080/19416520.2012.660762

Choi, J. N., & Kim, M. U. (1999). The organizational application of groupthink and its limitations in organizations. *Journal of Applied Psychology*, *84*(2), 297–306. http://dx.doi.org/10.1037/0021-9010.84.2.297

Clark, B. H., & Montgomery, D. B. (1998). Deterrence, reputations, and competitive cognition. *Management Science*, *44*(1), 62–82. https://doi.org/10.1287/mnsc.44.1.62

Dahlin, K., Chuang, Y.-T., & Roulet, T. (2017). Opportunity, motivation and ability to learn from failures and errors: Review, synthesis, and the way forward. *Academy of Management Annals*, annals.2016.0049. https://doi.org/10.5465/annals.2016.0049

Darr, E. D., Argote, L., & Epple, D. (1995). The acquisition, transfer, and depreciation of knowledge in service organizations: Productivity in franchises. *Management Science*, *41*(11), 1750–1762. http://dx.doi.org/10.1287/mnsc.41.11.1750

Delgado, M. R., Schotter, A., Ozbay, E. Y., & Phelps, E. A. (2008). Understanding overbidding: Using the neural circuitry of reward to design economic auctions. *Science*, *321*(5897), 1849–1852. http://dx.doi.org/10.1126/science.1158860

Denrell, J. (2003). Vicarious learning, undersampling of failure, and the myths of management. *Organization Science*, *14*(3), 227–243.

Derfus, P. J., Maggitti, P. G., Grimm, C. M., & Smith, K. G. (2008). The red queen effect: Competitive actions and firm performance. *Academy of Management Journal*, *51*(1), 61–80. http://dx.doi.org/10.5465/AMJ.2008.30708624

Doerflinger, J. T., Martiny-Huenger, T., & Gollwitzer, P. M. (2017). Planning to deliberate thoroughly: If-then planned deliberation increases the adjustment of decisions to newly available information. *Journal of Experimental Social Psychology*, *69*, 1–12. https://doi.org/10.1016/j.jesp.2016.10.006

Drummond, H. (1994). Escalation in organizational decision making a case of recruiting an incompetent employee. *Journal of Behavioral Decision Making*, *7*(1), 43–55. https://doi.org/10.1002/bdm.3960070104

Ellison, G., & Fudenberg, D. (1993). Rules of thumb for social learning. *Journal of Political Economy*, *101*(4), 612–643. http://dx.doi.org/10.1086/261890

Ellison, G., & Fudenberg, D. (1995). Word-of-mouth communication and social learning. *The Quarterly Journal of Economics*, *110*(1), 93–125. http://dx.doi.org/10.2307/2118512

Elster, J. (2000). *Ulysses unbound: Studies in rationality, precommitment, and constraints*. Cambridge, UK: Cambridge University Press.

Fennema, M. G., & Perkins, J. D. (2008). Mental budgeting versus marginal decision making: training, experience and justification effects on decisions involving sunk costs. *Journal of Behavioral Decision Making*, *21*(3), 225–239. https://doi.org/10.1002/bdm.585

Ferrier, W. J. (2001). Navigating the competitive landscape: The drivers and consequences of competitive aggressiveness. *Academy of Management Journal*, *44*(4), 858–877. http://dx.doi.org/10.2307/3069419

Fischhoff, B. (1982). Debiasing. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 422–444). New York, NY: Cambridge University Press.

Frank, R. H. (1999). *Luxury fever: Money and happiness in an era of excess*. Princeton University Press.

Garcia, S. M., & Tor, A. (2007). Rankings, standards, and competition: Task vs. scale comparisons. *Organizational Behavior and Human Decision Processes*, *102*(1), 95–108. http://dx.doi.org/10.1016/j.obhdp.2006.10.004

Garcia, S. M., Tor, A., & Gonzalez, R. (2006). Ranks and rivals: A theory of competition. *Personality and Social Psychology Bulletin*, *32*, 970–982. http://dx.doi.org/10.1177/0146167206287640

Garcia, S. M., Tor, A., & Schiff, T. M. (2013). The psychology of competition: A social comparison perspective. *Perspectives on Psychological Science*, *8*(6), 634–650. http://dx.doi.org/10.1177/1745691613504114

Gino, F., Argote, L., Miron-Spektor, E., & Todorova, G. (2010). First, get your feet wet: The effects of learning from direct and indirect experience on team creativity. *Organizational Behavior and Human Decision Processes*, *111*(2), 102–115. http://dx.doi.org/10.1016/j.obhdp.2009.11.002

Graf, L., König, A., Enders, A., & Hungenberg, H. (2012). Debiasing competitive irrationality: How managers can be prevented from trading off absolute for relative profit. *European Management Journal*, *30*(4), 386–403. http://dx.doi.org/10.1016/j.emj.2011.12.001

Greiner, B. (2015). Subject pool recruitment procedures: Organizing experiments with ORSEE. *Journal of the Economic Science Association*, *1*(1), 114–125.

Guler, I. (2007). Throwing good money after bad? Political and institutional influences on sequential decision making in the venture capital industry. *Administrative Science Quarterly*, *52*(2), 248–285. https://doi.org/10.2189/asqu.52.2.248

Gunia, B. C., Sivanathan, N., & Galinsky, A. D. (2009). Vicarious entrapment: Your sunk costs, my escalation of commitment. *Journal of Experimental Social Psychology*, *45*(6), 1238–1244. https://doi.org/10.1016/j.jesp.2009.07.004

Haran, U., & Ritov, I. (2014). Know who you're up against: Counterpart identifiability enhances competitive behavior. *Journal of Experimental Social Psychology*, *54*, 115–121. https://doi.org/10.1016/j.jesp.2014.04.009

Hart, E., Avrahami, J., Kareev, Y., & Todd, P. M. (2015). Investing even in uneven contests: Effects of asymmetry on investment in contests. *Journal of Behavioral Decision Making*, *28*(4), 395–409. https://doi.org/10.1002/bdm.1861

Haselhuhn, M. P., Pope, D. G., Schweitzer, M. E., & Fishman, P. (2012). The Impact of Personal Experience on Behavior: Evidence from Video-Rental Fines. *Management Science*, *58*(1), 52–61. https://doi.org/10.1287/mnsc.1110.1367

Heath, C. (1995). Escalation and de-escalation of commitment in response to sunk costs: The role of budgeting in mental accounting. *Organizational Behavior and Human Decision Processes*, *62*(1), 38–54. http://dx.doi.org/10.1006/obhd.1995.1029

Henderson, M. D., Gollwitzer, P. M., & Oettingen, G. (2007). Implementation intentions and disengagement from a failing course of action. *Journal of Behavioral Decision Making*, *20*(1), 81–102. https://doi.org/10.1002/bdm.553

Hertwig, R., Barron, G., Weber, E. U., & Erev, I. (2004). Decisions from Experience and the Effect of Rare Events in Risky Choice. *Psychological Science*, *15*(8), 534–539. https://doi.org/10.1111/j.0956-7976.2004.00715.x

Hertwig, R., Hogarth, R. M., & Lejarraga, T. (2018). Experience and Description: Exploring Two Paths to Knowledge. *Current Directions in Psychological Science*, 0963721417740645. https://doi.org/10.1177/0963721417740645

Hill, S. E., & Buss, D. M. (2006). Envy and positional bias in the evolutionary psychology of management. *Managerial and Decision Economics*, *27*(2–3), 131–143. https://doi.org/10.1002/mde.1288

Hoffman, P. J., Festinger, L., & Lawrence, D. H. (1954). Tendencies toward group comparability in competitive bargaining. *Human Relations*, *7*, 141–159. http://dx.doi.org/10.1177/001872675400700203

Hoover, J. D., Giambatista, R. C., & Belkin, L. Y. (2012). Eyes on, hands on: Vicarious observational learning as an enhancement of direct experience. *Academy of Management Learning & Education*, *11*(4), 591–608. https://doi.org/10.5465/amle.2010.0102

Hörisch, H., & Kirchkamp, O. (2010). Less fighting than expected. *Public Choice*, *144*(1–2), 347–367. http://dx.doi.org/10.1007/s11127-009-9523-y

Hsieh, K.-Y., Tsai, W., & Chen, M.-J. (2015). If they can do it, why not us? Competitors as reference points for justifying escalation of commitment. *Academy of Management Journal*, *58*(1), 38–58. http://dx.doi.org/10.5465/amj.2011.0869

Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. *Organization Science*, *2*(1), 88–115. http://dx.doi.org/10.1287/orsc.2.1.88

Janis, I. L. (1972). *Victims of groupthink: A psychological study of foreign-policy decisions and fiascoes*. Oxford, UK: Houghton Mifflin.

Jung, H., & Young, M. J. (2012). The de-biasing effect of incidental anger on other-provided anchors. *Journal of Behavioral Decision Making*, *25*(5), 435–442. https://doi.org/10.1002/bdm.739

KC, D., Staats, B. R., & Gino, F. (2013). Learning from my success and from others' failure: Evidence from minimally invasive cardiac surgery. *Management Science*, *59*(11), 2435–2449. http://dx.doi.org/10.1287/mnsc.2013.1720

Kilduff, G. J., & Galinsky, A. D. (2017). The spark that ignites: Mere exposure to rivals increases Machiavellianism and unethical behavior. *Journal of Experimental Social Psychology*, *69*, 156–162. https://doi.org/10.1016/j.jesp.2016.10.007

Kilduff, G. J., Galinsky, A. D., Gallo, E., & Reade, J. J. (2016). Whatever it takes to win: Rivalry increases unethical behavior. *Academy of Management Journal*, *59*(5), 1508–1534. https://doi.org/10.5465/amj.2014.0545

Kim, J.-Y. J., & Miner, A. S. (2007). Vicarious learning from the failures and near-failures of others: Evidence from the US commercial banking industry. *Academy of Management Journal*, *50*(3), 687–714. http://dx.doi.org/10.5465/AMJ.2007.25529755

Kirby, S. L., & Davis, M. A. (1998). A study of escalating commitment in principal–agent relationships: Effects of monitoring and personal responsibility. *Journal of Applied Psychology*, *83*(2), 206–217. http://dx.doi.org/10.1037/0021-9010.83.2.206

Kohn, A. (1992). *No contest: The case against competition*. New York, NY: Houghton Mifflin Harcourt.

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology*, *78*(2), 311. http://dx.doi.org/10.1037/0021-9010.78.2.311

Ku, G. (2008). Learning to de-escalate: The effects of regret in escalation of commitment. *Organizational Behavior and Human Decision Processes*, *105*(2), 221–232. http://dx.doi.org/10.1016/j.obhdp.2007.08.002

Ku, G., Malhotra, D., & Murnighan, J. K. (2005). Towards a competitive arousal model of decision-making: A study of auction fever in live and Internet auctions. *Organizational Behavior and Human Decision Processes*, *96*(2), 89–103. http://dx.doi.org/10.1016/j.obhdp.2004.10.001

Kühberger, A., & Perner, J. (2003). The role of competition and knowledge in the Ellsberg task. *Journal of Behavioral Decision Making*, *16*(3), 181–191. https://doi.org/10.1002/bdm.441

Kwong, J. Y. Y., & Wong, K. F. E. (2014). Reducing and exaggerating escalation of commitment by option partitioning. *Journal of Applied Psychology*, *99*(4), 697–712. http://dx.doi.org/10.1037/a0035484

Lakens, D. (2017). Equivalence Tests: A Practical Primer for t Tests, Correlations, and Meta-Analyses. *Social Psychological and Personality Science*, *8*(4), 355–362. https://doi.org/10.1177/1948550617697177

Lee, J. S., Keil, M., & Wong, K. F. E. (2015). The effect of goal difficulty on escalation of commitment. *Journal of Behavioral Decision Making*, *28*(2), 114–129. https://doi.org/10.1002/bdm.1835

Lehenkari, M. (2012). In search of the underlying mechanism of the disposition effect. *Journal of Behavioral Decision Making*, *25*(2), 196–209. https://doi.org/10.1002/bdm.727

Lejarraga, T., Woike, J. K., & Hertwig, R. (2016). Description and experience: How experimental investors learn about booms and busts affects their financial risk taking. *Cognition*, *157*(Supplement C), 365–383. https://doi.org/10.1016/j.cognition.2016.10.001

Levitt, B., & March, J. G. (1988). Organizational learning. *Annual Review of Sociology*, *14*, 319–340. http://dx.doi.org/10.1146/annurev.so.14.080188.001535

Loewenstein, G. (1996). Out of control: Visceral influences on behavior. *Organizational Behavior and Human Decision Processes*, *65*(3), 272–292. https://doi.org/10.1006/obhd.1996.0028

Loewenstein, G. (2000). Emotions in economic theory and economic behavior. *American Economic Review*, *90*, 426–432. http://dx.doi.org/10.1006/obhd.1996.0028

Malhotra, D. (2010). The desire to win: The effects of competitive arousal on motivation and behavior. *Organizational Behavior and Human Decision Processes*, *111*(2), 139–146. http://dx.doi.org/10.1016/j.obhdp.2009.11.005

Malhotra, D., Ku, G., & Murnighan, J. K. (2008). When winning is everything. *Harvard Business Review*, *86*(5), 78–86.

Manz, C. C., & Sims, H. P. (1981). Vicarious learning: The influence of modeling on organizational behavior. *Academy of Management Review*, *6*(1), 105–113. https://doi.org/10.5465/AMR.1981.4288021

March, J. G., Sproull, L. S., & Tamuz, M. (1991). Learning from samples of one or fewer. *Organization Science*, *2*(1), 1–13. https://doi.org/10.1287/orsc.2.1.1

Maslach, D., Branzei, O., Rerup, C., & Zbaracki, M. J. (2018). Noise as Signal in Learning from Rare Events. *Organization Science*. https://doi.org/10.1287/orsc.2017.1179

Massey, C., & Thaler, R. H. (2013). The loser's curse: Decision making and market efficiency in the National Football League draft. *Management Science*, *59*(7), 1479–1495. https://doi.org/10.1287/mnsc.1120.1657

McNamara, G., Moon, H., & Bromiley, P. (2002). Banking on commitment: Intended and unintended consequences of an organization's attempt to attenuate escalation of commitment. *Academy of Management Journal*, *45*(2), 443–452. http://dx.doi.org/10.2307/3069358

Milkman, K. L., Chugh, D., & Bazerman, M. H. (2009). How can decision making be improved? *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, *4*(4), 379–383. https://doi.org/10.1111/j.1745-6924.2009.01142.x

Mui, V.-L. (1995). The economics of envy. *Journal of Economic Behavior and Organization*, *26*, 311–336. http://dx.doi.org/10.1016/0167-2681(94)00079-T

Münster, J. (2007). Simultaneous inter-and intra-group conflicts. *Economic Theory*, *32*(2), 333–352. http://dx.doi.org/10.1007/s00199-007-0218-7

Murnighan, J. K. (2002). A very extreme case of the dollar auction. *Journal of Management Education*, *26*(1), 56–69. http://dx.doi.org/10.1177/105256290202600105

Nathanson, S., Brockner, J., Brenner, D., Samuelson, C., Countryman, M., Lloyd, M., & Rubin, J. Z. (1982). Toward the reduction of entrapment. *Journal of Applied Social Psychology*, *12*(3), 193–208. http://dx.doi.org/10.1111/j.1559-1816.1982.tb00859.x

Nordgren, L. F., Van Harreveld, F., & Van Der Pligt, J. (2009). The restraint bias: How the illusion of self-restraint promotes impulsive behavior. *Psychological Science*, *20*(12), 1523–1528. http://dx.doi.org/10.1111/j.1467-9280.2009.02468.x

Phillips, N. D., Hertwig, R., Kareev, Y., & Avrahami, J. (2014). Rivals in the dark: How competition influences search in decisions under uncertainty. *Cognition*, *133*(1), 104–119. https://doi.org/10.1016/j.cognition.2014.06.006

Piezunka, H., Lee, W., Haynes, R., & Bothner, M. S. (2018). Escalation of competition into conflict in competitive networks of Formula One drivers. *Proceedings of the National Academy of Sciences*, 201717303. https://doi.org/10.1073/pnas.1717303115

Prentice, D. A., & Miller, D. T. (1992). When small effects are impressive. *Psychological Bulletin*, *112*(1), 160–164. http://dx.doi.org/10.1037/0033-2909.112.1.160

Radzevick, J. R., & Moore, D. A. (2010). Competing to be certain (but wrong): Market dynamics and excessive confidence in judgment. *Management Science*, *57*(1), 93–106. https://doi.org/10.1287/mnsc.1100.1255

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, *69*(5), 379–399. http://dx.doi.org/10.1037/h0046234

Schelling, T. C. (2006). *Strategies of commitment and other essays*. Cambridge, MA: Harvard University Press.

Schulz-Hardt, S., Vogelgesang, F., Pfeiffer, F., Mojzisch, A., & Thurow-Kröning, B. (2010). When forewarning backfires: Paradoxical effects of elaborating social feedback on entrapment in a losing course of action. *Journal of Behavioral Decision Making*, *23*(4), 404–420. https://doi.org/10.1002/bdm.664

Sheldon, O. J., & Fishbach, A. (2011). Resisting the temptation to compete: Self-control promotes cooperation in mixed-motive interactions. *Journal of Experimental Social Psychology*, *47*(2), 403–410. https://doi.org/10.1016/j.jesp.2010.11.003

Shepherd, D. A. (2004). Educating entrepreneurship students about emotion and learning from failure. *Academy of Management Learning & Education*, *3*(3), 274–287. https://doi.org/10.5465/AMLE.2004.14242217

Sheremeta, R. M. (2010). Experimental comparison of multi-stage and one-stage contests. *Games and Economic Behavior*, *68*(2), 731–747. http://dx.doi.org/10.1016/j.geb.2009.08.001

Shubik, M. (1971). The dollar auction game: A paradox in noncooperative behavior and escalation. *Journal of Conflict Resolution*, *15*(1), 109–111. http://dx.doi.org/10.1177/002200277101500111

Simonson, I., & Staw, B. M. (1992). Deescalation strategies: A comparison of techniques for reducing commitment to losing courses of action. *Journal of Applied Psychology*, *77*(4), 419–426. http://dx.doi.org/10.1037/0021-9010.77.4.419

Sleesman, D. J., Conlon, D. E., McNamara, G., & Miles, J. E. (2012). Cleaning up the big muddy: A meta-analytic review of the determinants of escalation of commitment. *Academy of Management Journal*, *55*(3), 541–562. http://dx.doi.org/10.5465/amj.2010.0696

Snapp-Childs, W., Wilson, A. D., & Bingham, G. P. (2015). Transfer of learning between unimanual and bimanual rhythmic movement coordination: Transfer is a function of the task dynamic. *Experimental Brain Research*, *233*(7), 2225–2238. https://doi.org/10.1007/s00221-015-4292-y

Solnick, S. J., & Hemenway, D. (1998). Is more always better?: A survey on positional concerns. *Journal of Economic Behavior & Organization*, *37*(3), 373–383. https://doi.org/10.1016/S0167-2681(98)00089-4

Sousa, R. de. (n.d.). How evolutionary biology makes everyone an existentialist – Ronnie de Sousa | Aeon Essays. Retrieved December 27, 2017, from https://aeon.co/essays/how-evolutionary-biology-makes-everyone-an-existentialist

Staw, B. M. (1976). Knee-deep in the big muddy: A study of escalating commitment to a chosen course of action. *Organizational Behavior and Human Performance*, *16*(1), 27–44. http://dx.doi.org/10.1016/0030-5073(76)90005-2

Staw, B. M. (1981). The escalation of commitment to a course of action. *Academy of Management Review*, *6*(4), 577–587. http://dx.doi.org/10.5465/amr.1981.4285694

Staw, B. M. (1997). The escalation of commitment: An update and appraisal. In Z. Shapira (Ed.), *Organizational Decision Making* (pp. 191–215). Cambridge, UK: Cambridge University Press.

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes*, *82*(1), 9–27. http://dx.doi.org/10.1006/obhd.2000.2884

Teger, A. I. (1980). *Too much invested to quit*. New York, NY: Pergamon Press.

Thaler, R. H. (1988). Anomalies: The winner's curse. *Journal of Economic Perspectives*, *2*(1), 191–202. http://dx.doi.org/10.1257/jep.2.1.191

Thaler, R. H. (1999). Mental accounting matters. *Journal of Behavioral Decision Making*, *12*(3), 183–206. https://doi.org/10.1002/(SICI)1099-0771(199909)12:3<183::AID-BDM318>3.0.CO;2-F

Thorndike, E. L. (1913). *Educational psychology* (Vol. 2). New York, NY: Teachers college, Columbia University.

Tully, S., & Levenson, E. (2006). The (second) worst deal ever. *Fortune Magazine*, *154*(8), 102–119.

Van den Bos, W., Li, J., Lau, T., Maskin, E., Cohen, J. D., Montague, P. R., & McClure, S. M. (2008). The value of victory: Social origins of the winner's curse in common value auctions. *Judgment and Decision Making*, *3*(7), 483.

Walsh, J. P. (1995). Managerial and organizational cognition: Notes from a trip down memory lane. *Organization Science*, *6*(3), 280–321. http://dx.doi.org/10.1287/orsc.6.3.280

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037//0022-3514.54.6.1063

White, C. M., Hafenbrädl, S., Hoffrage, U., Reisen, N., & Woike, J. K. (2011). Are groups more likely to defer choice than their members? *Judgment and Decision Making*, *6*(3), 239–251.

Zikmund-Fisher, B. J. (2004). De-escalation after repeated negative feedback: Emergent expectations of failure. *Journal of Behavioral Decision Making*, *17*(5), 365–379. https://doi.org/10.1002/bdm.478

Table 1

Means, Standard Deviations and Medians of the Highest and Second-Highest Bids (in CHF) Across Conditions in Experiment 1a

		Highest bid			Second-highest bid		
Condition	Auction type	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*
Repeated dollar auction	Dollar (1st)	14.64	7.94	13.00	13.89	7.89	11.25
	Dollar (2nd)	5.39	3.47	5.25	4.32	3.63	3.25
First-price auction	First-price	9.46	1.55	10.00	8.93	1.62	9.75
	Dollar	16.33	11.37	11.75	13.04	6.55	11.25

Table 2

Means, Standard Deviations and Medians of the Highest and Second-Highest Bids (in CHF) in Experiment 1b

		Highest bid			Second-highest bid		
Condition	Auction type	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*
Executives	Dollar (1st)	15.32	8.51	13.25	14.96	8.48	13.00
	Dollar (2nd)	8.14	6.52	7.50	6.57	4.42	6.25

Table 3

Means, Standard Deviations and Medians of the Highest and Second-Highest Bids (in CHF) Across Conditions in Experiment 1c

		Highest bid			Second-highest bid		
Condition	Auction type	*M*	*SD*	*Mdn*	*M*	*SD*	*Mdn*
Goal setting	Dollar	29.93	38.26	12.75	28.21	39.10	11.00
Vicarious learning	Dollar (1st)	7.11	2.96	7.50	6.64	2.96	6.25
	Dollar (2nd)	3.32	3.27	2.00	2.25	3.01	1.25

Table 4

Descriptive Statistics Across Conditions in Experiment 2

TABLE 4
Dollar Auction Results Experiment 2

	Highest bid			% placed	% placed bid	%	N
Condition	*M*	*SD*	*Mdn*	bid	above 50 cents	"won"	
Baseline	64.6	35.05	52	100	54	22	50
Goal setting	55.5	32.31	50	100	39	10	41
Mental simulation general	63.3	39.19	50	96	49	27	51
Mental simulation escalation point	59.6	38.62	52	92	55	16	51

Table 5

Descriptive Statistics Across Conditions in Experiment 3

TABLE 5
Results Experiment 3

Condition	Highest bid			% placed bid	% placed bid above 50 cents	% "won"	N
	M	*SD*	*Mdn*				
Dollar auction games:							
Dollar auction (baseline)	42.2	33.03	38	95	26	11	195
Dollar auction after first-price auction (46)	59.9	38.07	51	94	50	26	106
Dollar auction after first-price auction (50)	48.8	42.05	48	86	43	20	102
Vicarious learning	34.0	32.34	26	88	18	8	200
Goal setting	43.0	33.92	32	94	28	10	196
Other games:							
First-price auction, opponent stops at 46	36.8	14.54	46	96	3	34	106*
First-price auction, opponent stops at 50	38.7	14.24	46	99	10	10	102*
Chicken game only	60.7	38.56	55	91	58	27	202
Chicken game after dollar auction (baseline)	43.5	42.6	30	73	38	23	194*

Total N = 1001. * within-subject conditions

Table 6

Overview of tested interventions to reduce competitive escalation

TABLE 6
Overview of tested interventions to reduce competitive escalation

Type of experience	Concrete intervention	Experiment	Hypothesis	Effective?
Direct experience				
in a competitive escalation situation	Playing the dollar auction			
	DV: Second dollar auction	1a, 1b	2	Yes
	DV: Dynamic chicken game	3	2	Yes
in a competitive situation without escalation	Playing a first-price auction	1a, 3	3	No
Indirect experience				
Vicarious learning	Learning about the payoffs of others	1c, 3	4	Yes
Mental simulation + Limit Setting	Mentally simulating the auction and setting a limit	1c, 2, 3	5	No
Mental simulation only	Mentally simulating the auction	2	-	No
Parlor trick	Mentally simulating the escalation point	2	-	No

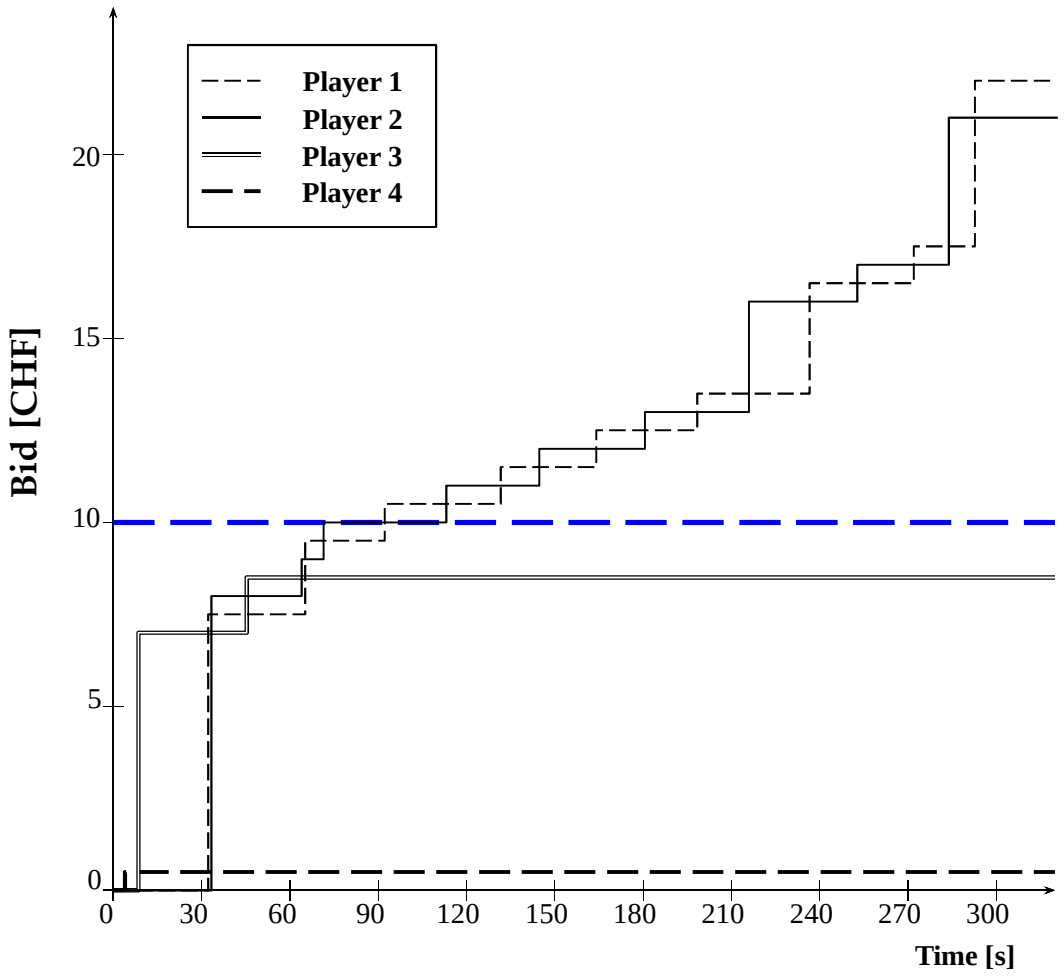

Figure 1. Example of the bidding process in the minimal dollar auction paradigm. The x-axis represents time, the y-axis represents bid values, and players' bids are represented by different line types. The blue dashed line marks CHF 10.00. Player 4 started the bidding by placing her only bid at CHF 0.5. Player 3 entered the auction next but dropped out after two bids (at approximately 45 seconds), leaving players 1 and 2 to bid against each other. They exceeded the CHF 10.00 mark in small steps, ending with player 1 making the highest bid of CHF 22.00 for CHF 10.00, and player 2 paying the second-highest bid of CHF 21.50 for nothing.

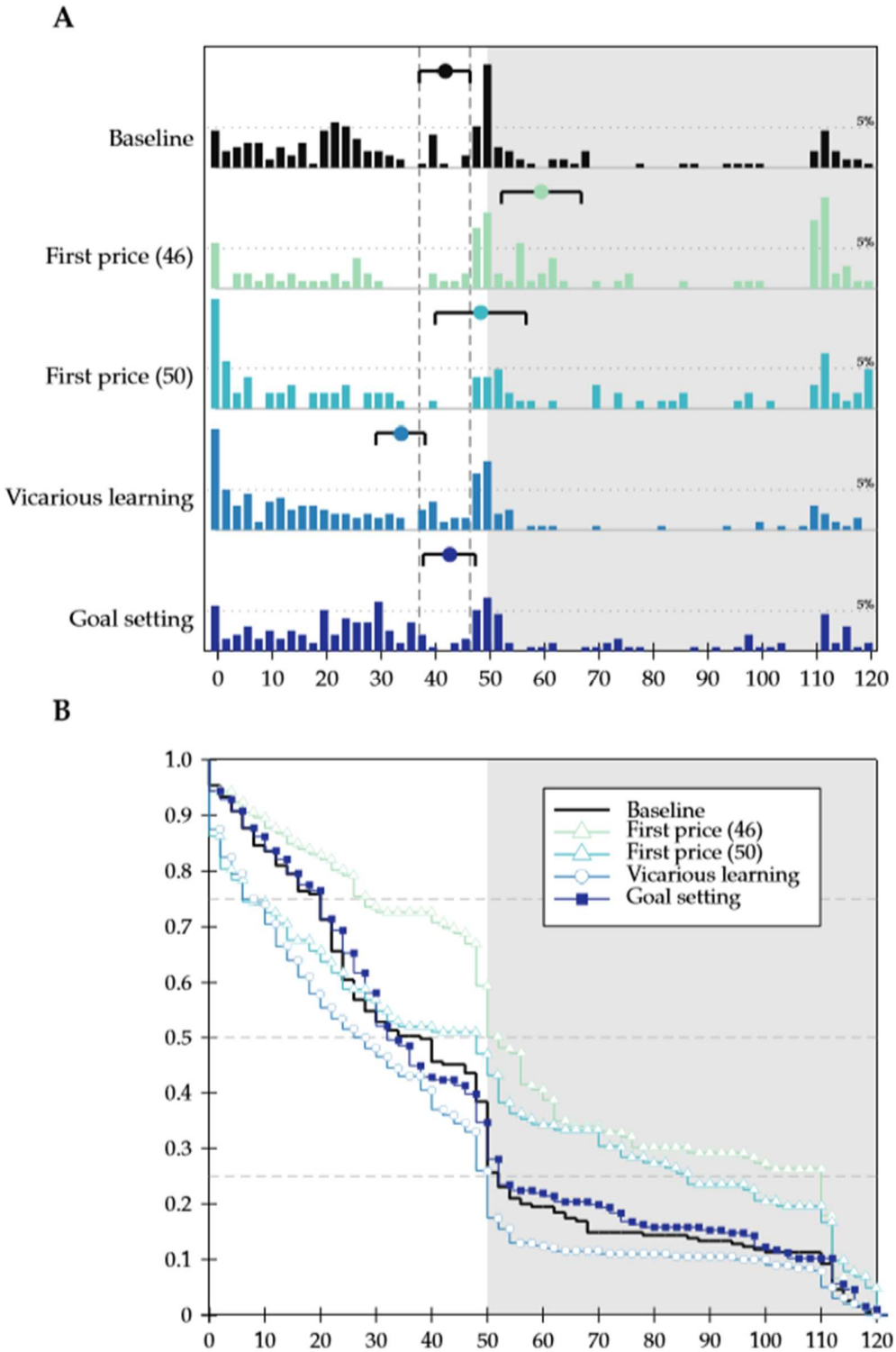

Figure 2. Results of Experiment 3. Panel A depicts the distribution of the highest bids in the dollar auction in each of the experimental conditions, including their means and 95% CIs. Panel B depicts the proportion of participants who are still in the game (on the Y-axis) as a function of the bid size (on the X-axis).

Appendix

1. Selected comments after Experiment 3, in response to the question "How did you experience the game you just played?" (in alphabetical order, unedited as entered by participants)

1. After learning that only 17 out of 100 people even made a few cents, while 80 of them lost money, it did not seem like it was worthwhile to play. It was extremely unlikely that I would win the .50, so why lose anything?
2. As one may notice from reviewing the results of the auction, I chose not to bid. In light of this, the game itself wasn't too interesting but formulating my approach was. I initially considered how I would behave if caught with a high bid, and realized hat I would likely be caught in a cycle of escalation that would cause me to lose money. The statistics that were then presented to me confirmed this suspicion, and in light of this I opted to use a safe position and keep my bonus by not bidding.
3. Ashamed at getting caught up in it
4. At first I was caught up in the bidding, then I realized it's dumb to bid money to win money. So I had a cutoff point where I wasn't really gaining much by continuing to bid.
5. Even though it was a computer I wanted to inflict financial damage to it when it drove the bid up past 50 cents
6. Felt like I was on a last minute bidding war on eBay. However, I felt no matter how much I bid, I was always going to be outbid all the way to 50 cents.
7. hoping the other player would back down - ha!
8. I am not entirely sure what is meant by this question, but I felt like it was a pretty good representation of human behavior. People don't want to be a loser, it's why the price escalates, because even thought you're in the hole you want to feel like a winer by coming out on top and making sure the guy you're playing against lost more money than you did.
9. I bid more than I thought I would because I got caught up.
10. I didn't like the odds presented before the auction, I felt that my chances of winning a bid were not worth going for. I tried out a bid to see if the computer would continue to increase the bid, and when it did, I instead decided to keep my cents.
11. I didn't see the point of bidding. If we escalate, then we both lose money. If I don't bid, the other player gets more, and I don't lose anything.
12. I didn't want to lose 50 cents, but I didn't want to quit bidding. Very frustrating!
13. I enjoyed it very much. It reminded me of those penny auction sites which I tried once several years ago. I was not successful during that auction either. For this game, I felt very competitive and determined to win. The payout really didn't matter, I jst wanted to win without losing money.
14. I enjoyed the experience and I liked the simulation of strategically bidding against competitors. I pretended that I was in a room with my competitor when responding with my bids. I felt the need to keep bidding in similar increments.

15. I enjoyed the experience. I have gotten in many bidding wars on eBay trying to get something I wanted and paid way more than I should of because I refused to lose.
16. I enjoyed the game. In the first 50 cent bidding I felt shut out. In the second scenario I was determined to win . Unfortunately I overpaid. Honestly as we progressed through the second process I was determined to win and punish the other bidder. I knew i they kept up bidding, I would win but receive the 50 cents and come out ahead of the other bidder. Sounds even dumber as I type it.
17. I enjoyed the game. It kept me on my toes and had me determined to win however after repeatedly losing against my opponent I wasn't sure that I would ever win.
18. I experienced an adrenaline rush accompanied by the feeling of pressure and anxiety. Also I heightened sense of trying to out guess my opponent.
19. I experienced it as stressful and irritating. The computer kept bidding past the point where I expected it to. During the part where I wasn't going to be paying my bid, I didn't mind bidding up to max, but during the part where I had to pay my bid, I ket bidding just so that I wasn't losing money for no reason and possibly to outbid the computer for spite. It was very annoying.
20. I experienced it competitively!!! I wanted to win!
21. I feel stupid honestly. I never normally act like that. I tend to cut and run and make safe choices.
22. I fell into the trap of bidding higher without thinking about the actual cost. Like many, I assume, winning became more important than the prize. I actually bid more than I could have won.
23. I felt as if it was a losing battle to win the bidding war. If I continued to bid both players would lose.
24. I felt as though in the end the game was rigged so that I lost my maximum bonus payment. But I really felt like I learned something about myself. I need to think more strategically before becoming too involved in situations where I stand to lose something
25. I felt competitive and was surprised the computer didn't stop the bidding.
26. I felt like at one point I was bidding to lose.
27. I felt that yes, I was getting sucked in to escalation behavior and I knew I should stop. I knew that my opponent was also stuck too. So I ended it because I knew there was no winning it.
28. I felt the getting sucked in to wanting to bet higher. And then I realized I will have to deduct what I bet. That made me stop.
29. I figured since 80% of participants lost money in the game, it would make the most sense to just keep my 1.20 bonus and come out even.
30. I found it frustrating. I wanted to win, but I didn't want to lose the money I already had.
31. i found it very competive. I had a feeling that we would never stop bidding.
32. I found it very stressful, similar to if I were gambling outside of the context of this survey.
33. I found myself giving in to the escalation behavior of the bidding process, but felt I had made a commitment to my highest bid and was going to stick to it. I felt going beyond my highest bid would be caused by my ego's desire to win more than the value o what I was bidding for.
34. I got way too caught up in the experience and overgambled.
35. I had chosen before it started to not pay anything for the bonus as the majority of people lost money. However once it began it was very hard to not bid. I felt anxious and it felt as though I was losing money by not bidding even though I knew that it wasmore likely I'd lose money by bidding.
36. i kept my maximum bid to under the goal i set to ensure i didn't go over in an escalation war.

37. I knew the computer would overbid me each time, so as I read the rules I set myself a limit and made the decision I would not bid over that limit. I think this game is fun for strategy, and might be a good way to teach children self control before they ar eligible to actually gamble.
38. I looked at the information given that only 17 players came out without losing money and assumed that the bidding escalated for either fear of losing or hope of winning. I opted to make a single bid to see if the other player would bid. They bid so I quit Better to lose a little than a lot.
39. I outbid more than I initially committed to spend. I felt compelled to win even though I knew I was going to be losing more and more money.
40. I realized as the bidding escalated, and both I and my computer opponent met and then passed the break-even point that this wasn't a winning auction, so much as a damage-control auction. Finally, I realized I'd do better to stop bidding so far past the vaue of what I was bidding on, and just accept the loss I'd so far accumulated. So I felt emotionally distressed as the bidding hit and then passed the value point of fifty cents.
41. I realized my mistaken strategy only after completing play, which made me a little mad at myself.
42. I realized that it would have been smarter to stop the bid immediately, instead of trying to go for the 50 cent bid, because I would only have to pay 2 cents. I got caught in the escalation war lol.
43. I saw that so many were losing money and I am one of those people who once I get started I cant stop. Based on the fact that there was a very good chance I would lose money even if I won the auction I chose not to bid at all and keep the entire 120
44. I thought at first I would only bid up to 25 cents but when the auction started I figured I already lost 25 cents so I might as well go for it all.
45. I thought it was a fun game. The more the other player bid, the more I wanted to bid in order to get the prize.
46. I thought it was much like real life, where you get competitive and try to beat the other guy even at a loss to yourself. But I tried to be smart and not get sucked in.
47. I thought the opponent would stop bidding once it got closer to and then passed .50. I was wrong though. I rarely take risks, this is why.
48. I thought to myself it would be "worth it" to pay up to half the value for the 50 cents but really this was stupid because I had to pay even though I lost. I should never have bid at all.
49. I tried to approach it calmly. After I set my limit initially and was thinking about it, I had a very brief moment of panic when you told me the limit I set wasn't going to be enforced automatically. It would have been so easy to fall into a bidding war, ut I felt like that wouldn't benefit me in the long run since the computer opponent had less to risk than I did in the end. Once I hit my limit I tried to push the I don't want to bid any more button as soon as possible so I didn't second guess myself.
50. I tried to win the bid, and now regret not going higher because if I had won the bid I'll still get the .50 and only would have lost a few cents to pay back compared to the whole amount I bid if I had won.
51. I wanted really wanted to win, but I also wanted to stick to my guns on how much I was willing to spend. But, I enjoyed the game all the same.
52. I wanted to win and lost sight of the goal.

53. I wanted to win even though it cost money and time. Competition makes us irrational?
54. I wanted to win no matter the cost, so I kept bidding
55. I wanted to win. I do not gamble but I found out that if I did, I would be a poor man.
56. I was a little surprised by how much the computer was willing to pay for the bid.
57. I was addicted to winning. I didn't want to back down even though I knew the price was getting too high.
58. I was anxious about loosing too much money, I had a set amount in my head that I would gamble and I went a little above what I previously decided. I knew the odds weren't good that I would win yet the allure still drew me in.
59. I was assuming the other player would stop bidding before the 50 cent mark, and I was a little confused at first why the bidding was still escalating after it exceeded 50 cents. After I realized I could only lose more money instead of gaining more, I trie to push it just a little bit higher, but I'd rather accept my loss of about 60 cents than keep pushing it up to 80 or $1.00. It was very frustrating after the amount exceeded 50 cents and I was mentally unprepared for a "strategy" or limit after it had ben exceeded.
60. I was aware that as soon as we started bidding, there would be no way to stop without just accepting our loss. Even once it gets to the point where we start to lose money, we would have to continue bidding to "minimize" the amount that we lost. Knowing tht, I decided to not bid and to just keep the initial 120 cents.
61. I was cautious with bidding, as I did not want to escalate and lose all possible money or have to pay.
62. I was competitive and wanted to win at all costs.
63. I was competitive. I was a little angry and at the moment did not really care about the money. It was about wining.
64. I was extremely determined to win the money as every cent counts in our household. I was determined to get more for my family. They were the motivation for me to continue to try.
65. I was pissed because the other person wouldn't quit bidding haha
66. I was tempted to keep upping my bid, but I didn't want to lose money, so I just stopped. I figured that the other player would just keep upping their bid too, so we'd both end up with very little or nothing left.
67. I wouldn't have really bid more than double what it was worth, but if I was going to lose it anyways, may as well go big.
68. It is like ebay. trying to get something you want an out bidding others to get even if you pay a higher price than you want to
69. It reminded me alot of e-bay. Bidding on something and not knowing when the other person will stop, or if they will stop at a reasonable point. I would often worry if I was in a bidding war on ebay for something I really wanted, if it really was a person oing the other bidding or if it was a bot. Knowing that the other bidder was a bot in this experience brought back memories of that.
70. It seemed somewhat realistic to how an actual person would play but at the same time, it also felt like it was a game that I couldn't win.
71. It was a little frustrating. I tested the water with a larger bid, and felt like we would have just competed in a bidding war and I would have lost all my bonus money. I much prefer to just walk away when I know I'm ahead rather than risking leaving with othing.
72. It was a little stressful wondering if to increase my bid

73. It was an interesting experience. I totally forgot about the consequences and got into the game too much.
74. it was an interesting game, I felt like when I'm bidding on ebay. This time it was easier to stop because I knew the actual value of the price and I wouldn't go as high as the value just to win.
75. it was exciting and kept pushing me wanting to outbid.
76. It was frustrating and it felt like a game of chicken
77. It was frustrating to me because I'm very competitive and eventually just lost the whole bonus.
78. It was fun but def could feel the urge to want to win.
79. It was fun, but also a bit nerve-racking. I lost track of the bidding objective and just wanted to beat my opponents bids, which probably not the right way to go about it.
80. It was interesting, I can understand the need to win over possibly losing money. I chose not to lose everything.
81. It was interesting. But it felt like the other player was going to continue outbidding until the end.
82. It was interesting. Once I passed 50 cents, I did not know what was the right choice anymore.
83. IT WAS JUST LIKE BIDDING ON EBAY, DROVE ME NUTS LOSING MY TOP BID!
84. It was kind of nerve racking I really anted to win but I also did not want to lose my money.
85. It was nerve wracking and I lamented the bids the computer opponent made against me. It was exciting overall though
86. My experience thought me that it is sometimes better to let the other person win.
87. My first thought was to just let the computer win the money because I would lose nothing, but then I got greedy and thought that maybe I could snag some extra money with a small bid. Then I kept escalating until I realized we could bid more than the actua value of the prize money. A shame.
88. My initial thought, which I wish I would have listened to, was to not bid and take my bonus without winning. Instead I tried to be the highest bidder but ended up losing my whole bonus.
89. My original thought was to stop around 30 cents but then I realized I would lose much more money so I kept going and ultimately I decided I was just going to lose money all the way around and there was no winning so I gave up and admitted defeat.
90. Seems like the best way to play the game is not to play the game.
91. Since I knew 80% lost money I didn't want to take the chance and I didn't bid.
92. That was fun! The first game there was no chance of losing real money so I kept bidding trying to win the .50. The second game however when I knew I would have to pay how much I bid, I bid a little trying to win the extra .50 but then stopped because I idn't want to lose any more money. Again this was really fun. Thanks!
93. The bidding game was intense. I wasn't sure what to do in terms of wanting to bid more or not.
94. The game made me somewhat angry because my opponent would not give up. I was also frustrated with myself because I would not give up and lost money due to my pride.
95. The game seemed like a lose lose situation honestly. I bet but when I was losing money I stopped betting.
96. The game was interesting. I started it determined not to bet too much and then found myself wanting to "beat" my opponent at the game and so I bid up higher than I'd anticipated doing. Surprised myself!

97. Tried to act the same as I would in real life. Made me nervous to lose control and spend too much.
98. Ups and downs in emotion
99. Very hostile. I felt I was playing against a real player.
100. You mean my strategy? Well, I thought of it as having $1.20, with a slight chance of gaining some extra money, but a greater chance of losing money. Since I couldn't know how logical the other decision maker was, I could very well have "won" the bidding, ut still lost money overall. And of course I could both lose the bidding and money. So I was only willing to bid a very low amount, and didn't try to play chicken with the ai bidding process. In short I had no confidence in my ability to find the optimal idding point, and just treated it as a loss management situation.

2. Regression tables

Regression analysis for Experiment 2.

Experimental condition	*B*	*SE*	*t*
baseline	0		
goal setting	-9.088	7.713	-1.18
mental simulation (general)	-1.345	7.286	-.18
mental simulation (escalation point)	-4.992	7.286	-.69
Constant	64.60***	5.177	12.48

*Note: N = 193, * p<0.05, ** p<0.001*

Regression analysis for Experiment 3.

Experimental condition	*B*	*SE*	*t*
baseline	0		
first price (46)	17.75**	4.237	4.19
first price (50)	6.611	4.291	1.54
vicarious learning	-8.109*	3.534	-2.29
goal setting	0.846	3.551	0.24
Constant	42.15**	2.514	16.77

*Note: N = 799, * p<0.05, ** p<0.001*

3. Appendix A: Game-Theoretic Analysis of the Dollar Auction

The game-theoretic analysis of the dollar auction is not trivial. To make the analysis tractable, some structure needs to be added. For simplicity, we assume that there are two players, that the prize for which they bid is *s*, and that the players' bankrolls (i.e., the maximal amount each player can bid) are given by *b1* and *b2*. Finally, we assume that an exogenous mechanism randomly assigns the right to make the first bid to one of the two players. This player can decide whether to place a bid or to drop out. If he places a bid, the auction continues, and the other player can also decide to bid or to drop out. The second player's bid has to surpass the first player's by at least one unit of money. The right to make a bid alternates until one of the players decides to drop out. The player who made the last bid wins the auction. O'Neill (1986) showed that if players are rational and have perfect foresight, there is always an equilibrium of the following form:

1. The first player places an initial bid.

2. The second player decides to drop out and the game is over.

O'Neill further showed that the optimal size of an initial bid that is sufficient to 'scare off' the second player depends on the details of the game. In particular, it matters whether or not the two players' bankrolls are identical.

In our experiment, the bankroll is not precisely defined. One could reasonably argue that the bankroll is identical for both players and corresponds to CHF 38.00, i.e., the amount

that participants earn during a 90-minute session in the lab. O'Neill demonstrated that in the case of identical bankrolls (*b1* = *b2* = *b*), the optimal initial bid is defined as[15]

$$(b - 1) \; mod \; (s - 1) + 1.$$

Given the parameters of our experiment, this equation yields an optimal initial bid of CHF 8.75.[16] However, because in our experiments the bankroll is not clearly defined, it is impossible for players to calculate the bid size for the equilibrium strategy. No player in any of the experiments—either those reported in the literature or our own—seems to have relied on the equilibrium strategy (calculated on the basis of the assumptions described above).

[15] 'mod' stands for Modulo, which is an operation that returns the remainder of an integer division. For instance, 7 mod 3 would return 1, as 7 = 3 x 2 + 1.

[16] CHF 38.00 is equivalent to 152 units of the minimal bid size of CHF 0.25. The stakes are CHF 10.00, or 40 units of CHF 0.25. Thus, the optimal bid can be calculated as (152 − 1) mod (40 − 1) + 1 = 35, which is CHF 8.75.