

# Bidding Frenzy: Speed of Competitor Reaction and Willingness to Pay in Auctions

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This research examines how the intensity of the dynamic competitive interaction with other bidders in ascending auctions influences consumers' willingness to pay (WTP) for auctioned products. It focuses on one important aspect of this interaction: the *speed of competitor reaction*. The key hypothesis is that having one's own bids reciprocated by competing bidders more quickly increases one's WTP in an auction. Evidence from five experiments demonstrates this effect and pinpoints the essential aspects of the psychological mechanism that underlies it. In particular, the effect of speed of competitor reaction on bidding behavior (1) is serially mediated by the perception that the auction is more intensely competitive and by a greater desire to win, (2) is distinct from the effects of time pressure and of the auction's duration or overall rate of progression, (3) is not driven by inferences about the auctioned product's market value, (4) is not qualified by the number of competing bidders nor due to any inferences about the latter, and (5) hinges on direct competitive interaction with other human bidders.

**Keywords:** auctions, bidding behavior, willingness to pay, competition among consumers, competitive dynamics, speed

Auctions involve direct competition among prospective buyers for the right to purchase a product. A common auction format is the open ascending auction (Krishna 2009;

Lucking-Reiley 2000), where consumers submit competitive bids for a product, and the high bid increases over the course of the auction. Consumers may be "outbid" by other auction participants, but they are free to reciprocate with an even higher bid of their own (McAfee and McMillan 1987). This process continues until nobody is willing to submit a bid in excess of the current high bid (or until a prespecified ending time), and whoever is the highest bidder at that point purchases the auctioned product for the winning bid amount.

The psychology of competition among consumers in auctions is not well understood. However, prior work suggests that the competitive interaction between bidders is an important aspect of auctions. For instance, there is evidence that bidders experience auctions as (sometimes intensely) competitive events (Ku, Malhotra, and Murnighan 2005; Malhotra 2010), and that they literally view other bidders as "competitors" (Ariely and Simonson 2003). Moreover, the possible outcome states of one's participation in an auction are typically referred to as "winning" and "losing" (Delgado et al. 2008). Yet very little is known about the potential consequences of interacting with competing bidders for how much consumers are ultimately

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willing to pay for products that they seek to buy in auctions.

We propose that the intensity of the dynamic competitive interaction with other bidders in an auction has a systematic influence on a consumer's willingness to pay (WTP) for the auctioned product, which we conceptualize as the amount of money she is prepared to give up to acquire the product via that particular auction. We focus on one key aspect of this interaction, the *speed of competitor reaction*—that is, how quickly one's bids are reciprocated by other auction participants. Our central hypothesis is that greater speed of competitor reaction causes consumers to perceive an auction to be more intensely competitive, and that this induces a greater desire to win, ultimately resulting in an increased WTP for the auctioned product.

Findings from five experiments provide evidence in support of the proposed effect, and they pinpoint the essential aspects of the psychological mechanism that underlies it. Greater speed of competitor reaction causes a higher WTP, and this effect is serially mediated by greater perceived competitive intensity of the auction and an increased desire to win. The results also indicate that the construct of perceived competitive intensity is distinct from that of competitive arousal. Moreover, the evidence presented here shows that the impact of the speed of competitor reaction on WTP is not due to time pressure, and that it is not driven by consumers' inferences about a product's market value (e.g., its retail price) or about the number of competing bidders, nor is it moderated by the number of auction participants when the latter is known. In addition, the findings demonstrate that the effect is not caused merely by the fact that an auction progresses more quickly overall, and they implicate the speed at which a human competitor (as opposed to a computer program) reciprocates one's bids as the root cause of the phenomenon.

## CONCEPTUAL FRAMEWORK

### Consumers' Construction of Their Willingness to Pay in an Auction

We conceptualize a consumer's willingness to pay for a product in an ascending auction as the maximum amount of money that she is willing to give up in order to obtain that product while immersed in the auction experience (Bajari and Hortagsu 2004; Chan, Kadiyali, and Park 2007; Park and Bradlow 2005). Most consumer products are what the auction literature refers to as private-value (as opposed to common-value) goods. According to the economic theory of ascending auctions for independent private-value goods, the optimal strategy for consumers is to bid up to their valuation in the course of the auction (Cramton 1998).

However, the actual amount that a bidder is willing to pay for an item tends to be different, as WTP in an auction

is also influenced by what the bidder observes or experiences during the auction (Ariely and Simonson 2003; Häubl and Popkowski Leszczyc 2003). For instance, prior work has shown that consumers' WTP may be influenced by factors such as a minimum bid (Ariely and Simonson 2003; Häubl and Popkowski Leszczyc 2003; Kamins, Drèze, and Folkes 2004), the opportunity to bypass the bidding process and purchase an item instantly at a "buy now" price (Popkowski Leszczyc, Qiu, and He 2009), the selling prices in other auctions (Nunes and Boatwright 2004), the number of bidders (Ku et al. 2005; Malhotra 2010), and the number of bids submitted (Heyman, Orhun, and Ariely 2004). This is consistent with the well-established notion that people tend to construct an object's value to them based on contextual factors (Ariely, Loewenstein, and Prelec 2003; Johnson, Häubl, and Keinan 2007).

Consumers' construction of their WTP for a product during the course of an ascending auction is consistent with some normative models of bidding—specifically those in which the value of a product is not assumed to be independent across bidders (i.e., private values are affiliated, or valuations are common; Kagel, Harstad, and Levin 1987; Milgrom and Weber 1982). In such models, the observed bidding behavior of other auction participants provides information about the value of the auctioned item, and consumers take this into account when making their own bidding decisions (McAfee and McMillan 1987). However, while the speed of competitor reaction could conceivably affect bidders' inferences about the objective value of an auctioned product along these lines, the central thesis of the present research is that how quickly one's bids are reciprocated by other auction participants affects WTP via a mechanism that cannot be accounted for by such economic principles. In particular, the proposed psychological mechanism does not involve changes in judgments about a product's market value (as indicated, for example, by its retail price). Instead, we hypothesize that greater speed of competitor reaction causes consumers to experience an auction as more intensely competitive, and that this increases their desire to win the auction, which ultimately results in a higher WTP for the auctioned product.

### Speed of Competitor Reaction and Perceived Competitive Intensity

One aspect of how quickly a consumer's bids in an auction are reciprocated by other bidders is simply that more rapid competitor reactions accelerate the overall pace of the auction. Prior research has examined the role of pace in settings where an auction's rate of progression was determined exogenously. This was done either in descending (or "Dutch") clock auctions (Katok and Kwasnica 2008) or in ascending clock auctions (Adam, Krämer, and Müller 2015), with auction pace in both cases being entirely outside the control of bidders. By contrast, the present work

examines the effect of how quickly competing bidders choose to respond to a consumer's bids.

Moreover, when the pace of an auction is determined exogenously, this is akin to imposing more or less time pressure on bidders by controlling the amount of time that is available to them for making their bidding decisions. Critically, the independent variable at the center of the current investigation—speed of competitor reaction—is distinct from time pressure. While the latter refers to how much time bidders have to make their bidding decisions, the speed of competitor reaction refers to the amount of time that passes before a consumer's bid is surpassed by someone else's bid, which does *not* affect the amount of time that is available for placing the next bid.

Our key hypothesis is that consumers interpret the amount of time that passes before their bids are surpassed by others in ascending auctions as a signal of the competitive intensity of these auctions. In particular, we propose that the experience of being outbid quickly indicates that another bidder is determined to win the auction, has a WTP that is significantly higher than the current high bid, and thus did not have to give much thought to whether to continue bidding. Consequently, having their bids surpassed at a fast pace should inform consumers' judgment of how contested the auction is. Specifically, we hypothesize that greater speed of competitor reaction in an ascending auction causes consumers to perceive the auction as more intensely competitive, and that this in turn leads to a greater desire to win the auction, which ultimately increases their WTP for the auctioned product.

While the current work is the first to examine the consequences of how quickly auction participants choose to respond to others' bids, a related phenomenon has been studied in the domain of bilateral bargaining. [Srivastava and Oza \(2006\)](#) found that people tend to be more satisfied with a negotiated outcome when their offer was accepted after a delay rather than immediately, and that this is due to inferences about how conflicted the bargaining opponent was about the offer, with the delay indicating that she required more time to deliberate and deemed the offer less attractive. Thus, in a bargaining context, greater reaction speed might signal lower competitive intensity, which is the opposite of what we propose to be the case in the domain of ascending auctions. We resolve this apparent contradiction by recognizing that the amount of deliberation that an opponent engages in reflects different things in different contexts. We propose that the key feature of settings where greater response speed has a negative effect on perceived competitive intensity is that the likelihood of an action or move resulting in the desired outcome increases as a function of the amount of deliberation that goes into it. This is the case in bargaining ([Srivastava and Oza 2006](#)), and it also applies to interactive games that require a significant amount of thought, such as chess ([Mazur, Booth, and Dabbs 1992](#)). By contrast, when a consumer is bidding in an ascending auction, taking more

time to deliberate does not increase the likelihood of the desired outcome (i.e., winning the auction); indeed, it tends to reduce it. Thus, while greater reaction speed may indicate that an opponent is less determined in some contexts, we argue that it signals *greater* determination, and consequently higher competitive intensity, in an auction setting.

It should be noted that the construct of perceived competitive intensity is distinct from the notion of "competitive arousal" ([Ku et al. 2005](#); [Malhotra 2010](#)). The latter is thought to be an emotional response that impairs decision making in competitive settings, and that is induced when one competes against a small number of opponents and when one is under time pressure. By contrast, perceived competitive intensity represents an inferential *judgment* (of how intensely competitive an auction is). Moreover, the key antecedent of perceived competitive intensity—the speed of competitor reaction—is unique to the current research and distinct from those of competitive arousal. Some aspects of an auction setting/experience primarily trigger affective responses (such as competitive arousal), while others tend to influence inferential judgments (such as perceived competitive intensity). Time pressure is an instance of the former ([Ku et al. 2005](#); [Malhotra 2010](#)), and the speed of competitor reaction is an instance of the latter.

Our theorizing does not hinge on the number of opponents in an auction (see below), and it provides a crisp conceptual distinction between the speed of competitor reaction and time pressure (see above). These points are empirically affirmed by the results of experiment 5, in which we measured competitive arousal (using the same two-item index as [Ku et al. 2005](#)) in addition to perceived competitive intensity.

To recap, we propose that the speed of competitor reaction has a systematic effect on consumers' judgments about how competitive an auction is. In particular, we hypothesize that seeing one's own bids being surpassed by opponents' bids more rapidly increases the perceived competitive intensity of the auction. One critical aspect of our theorizing is that, since the competitive interaction among bidders is an inherently social phenomenon ([Cheema et al. 2005](#); [Smith 1989](#)), this effect hinges on the consumer's belief that the timing of competitor reactions directly reflects the instantaneous decisions of other human bidders. Thus, in settings where reaction speed is exogenously determined (such as by an auction clock that dictates the pace of the competitive interaction among bidders or by software tools that place bids on behalf of human auction participants), we would not expect it to have any impact on how intensely competitive consumers perceive an auction to be.

### Perceived Competitive Intensity, Desire to Win, and Willingness to Pay in Auctions

Our theorizing about how consumers' perception of an auction's competitive intensity influences their WTP for an

auctioned product is informed by prior research in various disciplines. It is well established that competition among individuals has motivational consequences (Allport 1924; Balague 2009; Beersma et al. 2003; Deutsch 1949; Fehr and Schmidt 1999; Loewenstein, Thompson, and Bazerman 1989; Stanne, Johnson, and Johnson 1999). In particular, when multiple people pursue the same goal in a social setting, more intense interpersonal competition or rivalry tends to boost individuals' motivation to achieve that goal (Fishbach, Steinmetz, and Tu 2016; Hays 2012; Kilduff 2014). Moreover, building on the notion that bidding behavior in auctions may be governed, in part, by the anticipated joy of winning (Astor et al. 2013; Delgado et al. 2008), the prospect of emerging as the winner of an auction should be more appealing when the latter is perceived as more intensely competitive. In line with this, we propose that, in the context of competition among consumers in an ascending auction, this increase in motivation manifests itself in the form of stronger *desire to win* (Malhotra 2010). A bidder's desire to win an auction is a key driver of her bidding behavior. However, this desire can be ignited by distinct antecedents, which can be either (1) primarily automatic, emotional reactions to aspects of the auction setting (such as time pressure and the number of bidders, as shown by Malhotra 2010) or (2) more deliberative judgments about the intensity of competition based on the interaction with other bidders (as examined in the current work).

A consumer's desire to win an ascending auction should have a systematic effect on her bidding behavior in the course of the auction. Specifically, we hypothesize that a greater desire to win causes a consumer to be more persistent at remaining in the auction and, thus, bid up to a higher amount. This proposed positive effect of bidders' desire to win on their WTP in the auction is consistent with recent findings suggesting that interpersonal competition stimulates desire and increases how much participants want an object, without affecting how much they like the object (Larsen et al. 2015). Moreover, our theorizing is in line with consumers reacting to an obstruction of their goal to acquire a specific object with an increased wanting of (i.e., WTP for), but not liking of, the desired object (Litt, Khan, and Shiv 2010) in that intense competition by other bidders in an auction threatens the successful pursuit of one's goal to obtain the auctioned product.

In sum, we hypothesize that greater speed of competitor reaction causes consumers to perceive an auction to be more intensely competitive, and that this in turn leads to a stronger desire to win the auction, which ultimately increases their WTP for the auctioned product.

## Overview of Predictions

The overarching theme of this research is that the speed of competitor reaction is an important aspect of the experience of interacting with other bidders in an ascending

auction, and that it has a systematic impact on how much consumers ultimately bid for an auctioned product. Our key hypothesis is that being outbid by other auction participants more quickly increases consumers' WTP, and that it does so via the perception that the auction is more intensely competitive and the resulting enhanced desire to win.

Our theorizing about how the speed at which consumers' own bids are surpassed by others' bids affects their WTP for an auctioned product also implies the following additional predictions:

- The positive effect of the speed of competitor reaction on bidders' WTP is driven specifically by the rate of arrival of other auction participants' bids, and not by the auction's duration or overall rate of progression.
- The effect is not driven by bidders' perception of time pressure.
- The effect is not driven by bidders' inferences about the number of competing bidders based on the arrival rate of others' bids. (However, we will examine whether the effect of speed of competitor reaction on WTP is robust to variation in the number of bidders.)
- The effect is not driven by bidders' inferences about the auctioned product's market value, as indicated by an estimate of its retail price.
- The effect hinges on direct competitive interaction with other bidders. In particular, attribution of the rate of arrival of competing bids to anything other than the decisions of human competitors should eliminate the effect.

We present evidence from five experiments that were designed to test these predictions.

## EXPERIMENT 1

Experiment 1 provides a first test of our key hypothesis that greater speed of competitor reaction leads to higher WTP in ascending auctions. To that end, we manipulated participants' auction experience in terms of how quickly their own bids were surpassed by other auction participants' bids.

## Method

Due to the massively interactive nature of ascending auctions, rigorous investigation of the causal influences on the behavior of individual bidders in such auctions is a challenging endeavor. The key difficulty in this regard arises from the fact that many of the variables that might affect a bidder's behavior are endogenous in the sense that they reflect the actions of other bidders, which in turn may have been influenced by various events that have occurred in the auction, including earlier bids by competing auction participants. Therefore, bidding behavior observed in actual ascending auctions does not provide conclusive evidence about the causal influence of the speed of competitor reaction on bidding behavior. To isolate this effect, we



developed an experimental paradigm that allowed us to make the speed of competitor reaction *exogenous* and, thus, manipulate it experimentally.

Another limitation of observed bidding behavior in real-world ascending auctions is that it may reveal little about individual bidders' WTP for the auctioned products. Indeed, it provides accurate information only about the WTP of the runner-up (i.e., the participant who submits the second-highest bid). The winner of the auction has no incentive to bid up to her WTP (as it is sufficient to outbid the runner-up), and her highest bid thus merely reveals a lower bound on her WTP. Moreover, for any other auction participant, one can conclude only that her WTP was no less than her highest bid (lower bound) and no higher than the winning bid (upper bound). This is due to the fact that bidders are free to passively observe the progression of an ascending auction, having a compelling incentive to bid only in order to prevent the auction from closing with another bidder winning it at an amount below their WTP (Haile and Tamer 2003; Zeithammer and Adams 2010). To overcome this issue, the experimental paradigm we used was designed to incentivize every single participant to reveal their WTP, by continuing to incrementally outbid participants and observe their drop-out point, in what they believed was an ascending auction.

The experiment was conducted in a research lab at a major North American university. A total of 122 undergraduate business students participated in exchange for research credit. Participants believed that they participated in an actual computer-mediated ascending auction for a Patagonia® fleece sweater along with nine other bidders. To ensure that the product had broad appeal among bidders, participants were informed that the winning bidder in each auction would be able to select any of 10 colors and any of six sizes for the sweater (see figure 1). In fact, the auction was simulated in that the apparent bids of other participants were generated by a computer program. That is, participants bid against a "bidding machine" that mimicked the behavior of human auction participants. Tests for suspicion conducted as part of the debriefing (for all experiments) revealed that this created a highly effective illusion, providing no indication that any of the participants doubted that they were participating in an actual auction along with other human bidders.

The auctions were fully computer-mediated. Each participant used a private real-time bidding interface that displayed a detailed description (including an image) of the auctioned product, as well as the current high bid. This interface provided participants with the opportunity to submit their own bid at any time. A sample screenshot of the bidding interface is shown in figure 1. The auctions used a soft ending rule (Roth and Ockenfels 2002), whereby an auction ended once 60 seconds had passed without a new bid being submitted by any of the auction participants. All

bids had to be multiples of \$1. The lowest possible starting bid was \$1.

Participants' bids were economically consequential. By submitting a bid, they committed to buying the auctioned product should the auction end with theirs being the highest bid. To ensure that all participants understood this, we used an elaborate consent procedure, which included a test of understanding of the terms of the auction. Participants were free to not bid at all if they did not wish to do so. However, they were required to continue to follow the auction (by watching the bidding interface) until it was completed. (All participants did submit bids.)

A key feature of this experimental paradigm is that the bidding machine was programmed to continue to outbid participants, according to a prespecified protocol, until they ceased to submit bids. In line with the theory of ascending auctions (Cramton 1998), participants had an incentive to continue bidding until the current high bid exceeded their WTP for the auctioned product. No participant ended up as the highest bidder (i.e., buyer) upon completion of the auction. The dependent variable of interest was a bidder's WTP, which was operationalized as the final—and thus highest—bid submitted by a participant. (To reinforce the illusion that it was possible for participants to win their auction, several confederates who ended up as winners were placed in each session.)

We used the behavior of the bidding machine—in terms of how it reacted to the bids submitted by a participant—to implement the manipulation of the *speed of competitor reaction*. Participants were randomly assigned to one of two experimental conditions: either 30 seconds (low speed) or 10 seconds (high speed) after they had submitted a bid, another auction participant placed a bid that exceeded their most recent bid by \$1. (This manipulation was in effect from the start, whereby another auction participant placed an initial \$1 bid 30/10 seconds into the auction unless the participant had already submitted a bid by then.) The auction ended once the participant did not submit a bid for 60 seconds following someone else's bid, implying an automatic reset of the bid clock on submission of each new bid. Thus, irrespective of the speed of competitor reaction, participants always had one minute to decide whether to submit another bid of their own.

Sessions of the experiment were conducted with approximately 20 participants at a time, each seated at a computer in a private cubicle. Participants were able to see only their own monitor. No communication among participants was permitted. Participants were originally recruited for another study. At the beginning of the session, they were informed that, before starting that study, they would have an opportunity to participate in an auction for a product that might appeal to them. They were instructed that they would be randomly assigned to one of several auctions

FIGURE 1  
BIDDING INTERFACE

**Auction in progress**

**Patagonia Fleece Sweater**

- Unisex product
- Premium-quality lightweight PCR polyester fleece
- Breathable membrane barrier to block out wind
- Y-joint sleeves
- Deep front zipper for adjustable ventilation
- Large pouch pocket with polyester mesh lining
- Double-fabric stand-up collar
- Contrasting trim on collar, zipper, cuffs, and straight hem
- Weight: 454 grams (16 oz.)
- Made from 90% recycled materials
- Machine washable and dryable

**Colors:**

- Cerulean
- Blueblack
- Gull Grey
- Deep Cayenne Heather
- Green Spark Heather
- Majestic Purple
- Sage Khaki Heather
- Tar
- Tequila Gold Heather
- Celery

**Sizes:**

- XS
- S
- M
- L
- XL
- XXL

Current high bid: \$ 23 (someone else's bid)

Enter your new bid here: \$

[Click here to submit your bid](#)

**Note:** Amounts are in Canadian Dollars

(along with a known number of other participants). Bidders were told that the total pool of auction participants included all participants who were in the room at the time and another group of participants in a different room in the same lab. This was done to discourage participants from trying to infer who might be in their auction.

Before the start of the auction, participants were given detailed oral and written instructions, including a description of the auction format, and required to pass a test on the auction rules to ensure, for instance, that they understood that placing a bid implied a binding financial commitment. They were then asked to enter an auction participant code. After a short delay, purportedly required to randomly assign participants to auctions and to connect the bidders in each auction, the auction began. Participants were not provided with any information about the identity of other bidders in their auction. In the bidding interface, the current high bid was labeled either “your bid” or “someone else’s bid” (see figure 1).

Once the auction had ended, participants completed a short computer-based survey. They were asked to indicate how intense they thought the competition among bidders was in the auction (0 = not at all intense, 10 = extremely intense), and to estimate the retail price of the auctioned fleece sweater. In addition, the survey included measures of the extent of participants’ prior experience at bidding in

auctions, of their expertise in the product domain, and of the amount of difficulty they had in assessing the value of the auctioned product (all three: 0 = very low, 10 = very high), as well as their gender. (None of the latter four variables influenced the dependent variables or interacted with any of the independent variables in any of the experiments, and thus they are not discussed further.) After completing the survey, participants proceeded to another study. Summary statistics for the key variables (across all five experiments) are provided in appendix A.

## Results

**Estimated Retail Price.** The manipulation of the speed of competitor reaction did not affect participants’ estimates of the auctioned product’s retail price ( $M_{\text{low}} = 57.86$ ,  $M_{\text{high}} = 59.22$ ;  $F(1, 120) = .66$ ,  $p > .7$ ).

**Willingness to Pay.** The results of an analysis of variance (ANOVA) with each individual participant’s highest bid for the auctioned product as the dependent variable reveal a significant main effect of the speed of competitor reaction ( $F(1, 120) = 4.49$ ,  $p < .05$ ). In line with our key hypothesis, having one’s bids reciprocated by other auction participants more quickly increased participants’ WTP for the auctioned product. On average, participants’ final bids were \$24.05 when competing bidders outbid them with a

30 second delay and \$29.57 when the same competitor reaction occurred with a 10 second delay.<sup>1</sup>

*Perceived Competitive Intensity.* As predicted, participants perceived the auction to be more intensely competitive when their bids were surpassed by others more quickly ( $M_{\text{low}} = 5.79$ ,  $M_{\text{high}} = 6.63$ ;  $F(1, 120) = 4.13$ ,  $p < .05$ ). To examine whether this increase in the auction's perceived competitive intensity underlies the positive effect of speed of competitor reaction on WTP, we conducted a mediation analysis using a bootstrap approach (Preacher and Hayes 2008). The results reveal that the indirect effect of speed on WTP via perceived competitive intensity is significant ( $a \times b = 1.412$ ), with a 95% confidence interval excluding zero (.072 to 3.271), whereas the direct path from speed to WTP is not significant once the indirect effect is accounted for ( $p > .1$ ). Thus, the positive effect of a greater speed of competitor reaction on WTP was fully mediated by an increase in the perceived competitive intensity of the auction, representing a case of indirect-only mediation (Zhao, Lynch, and Chen 2010).

## Discussion

The results of experiment 1 show that, as hypothesized, greater speed of competitor reaction in ascending auctions leads to a higher WTP for the auctioned product. Having their bids reciprocated by another auction participant after 10 seconds increased participants' WTP for the sweater by 22% compared to when these competitor bids arrived with a 30 second delay. Moreover, this effect of the speed of competitor reaction on WTP was mediated by an increase in the auctions' perceived competitive intensity, also in line with our predictions.

Importantly, while bidders' WTP for the auctioned product was strongly impacted by the speed of competitor reaction, their estimates of its retail price were not. This indicates that the intensity of the competitive interaction among bidders in ascending auctions can influence consumers' WTP in the course of the auction without affecting judgments about a product's market value.

An implication of our manipulation of the speed of competitor reaction in experiment 1 was that, when a participant's bids were reciprocated more quickly, the current high bid in the auction increased at a faster pace. To examine the possibility that the effect on WTP might have been due to the fact that the auction's high bid was raised more rapidly rather than the speed of competitor reaction, experiment 2 was designed to disentangle these two aspects.

## EXPERIMENT 2

The primary objective of experiment 2 was to examine the influence of the speed of competitor reaction on consumers' WTP for an auctioned product while controlling for how quickly the current high bid of the auction advanced. To that end, we independently manipulated both the speed with which a participant's bids were reciprocated by a competing auction participant (as in experiment 1) and the amount by which a competitor's bid exceeded the participant's bid. This created two critical conditions that were comparable in terms of the pace at which the auction's high bid increased, but that differed in how this occurred—the participant being outbid (1) more quickly by smaller amounts or (2) more slowly by larger amounts. This approach allowed us, as a secondary objective, to also examine the possible influence of competitors' bids that exceed one's previous high bid by more than the minimum bid increment, also known as “jump bids” (Avery 1998; Easley and Tenorio 2004), on consumers' WTP for a product.

## Method

The overall procedure was the same as that of experiment 1. Seventy-eight undergraduate business students completed the experiment in exchange for research credit. They were randomly assigned to one of four conditions in a 2 (speed of competitor reaction: low vs. high)  $\times$  2 (increment of competitors' bids: low vs. high) between-subjects design.

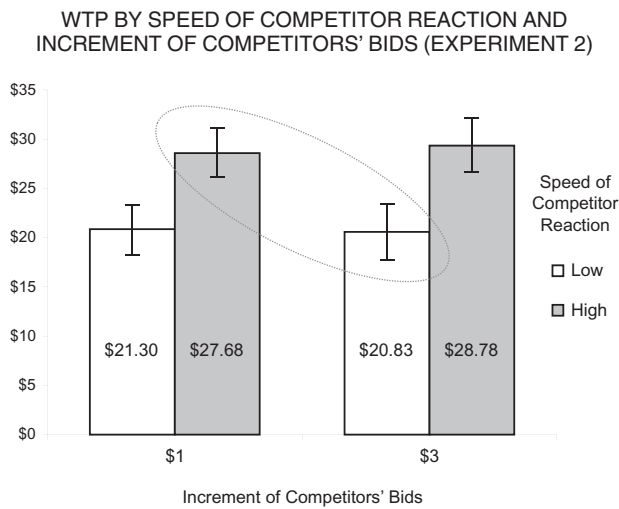
The speed of competitor reaction was manipulated as in experiment 1, with competitor bids arriving with a delay of either 30 seconds (low) or 10 seconds (high) following the most recent bid by the participant. The increment of competing bids was either \$1 or \$3. The \$3 increment was chosen to offset the lower speed of competitor reaction by proportionately larger bid increments; that is, the velocity of the increase of the auction's current high bid in the 10 second/\$1 condition matched that in the 30 second/\$3 condition (as closely as possible). After the auction, participants completed a short survey with the same measures that were used in experiment 1. In addition, participants were asked to indicate how fast-paced they thought the auction was (0 = slow, 10 = fast).

## Results

*Manipulation and Confounding Checks.* Participants perceived the auction to be faster-paced when their bids were reciprocated by another bidder after 10 seconds ( $M = 6.28$ ) than when this occurred after 30 seconds ( $M = 4.05$ ;  $F(1, 74) = 10.24$ ,  $p < .01$ ), indicating that the manipulation of the speed of competitor reaction was successful. Neither the increment of competitors' bids nor its

<sup>1</sup> These findings are robust to violations of the assumption of normality. The analyses for all experiments were replicated using the log-transformed WTP, which consistently produced the same qualitative results.

FIGURE 2



interaction with the speed of competitor reaction had a significant effect on the perceived pace of the auction (both  $p$  values  $> .3$ ).

**Estimated Retail Price.** The manipulations of the speed of competitor reaction and of the magnitude of the increment of competitors' bids did not influence participants' estimates of the auctioned product's retail price ( $M = 64.69$ ; all  $p$  values  $> .4$ ).

**Willingness to Pay.** The results of an ANOVA with participants' WTP for the auctioned product as the dependent variable indicate a significant main effect of the speed of competitor reaction ( $F(1, 74) = 4.76$ ,  $p < .05$ ), but no main effect of competitor bid increment and no interaction between these two factors (both  $p$  values  $> .8$ ). In line with our key hypothesis, greater speed of competitor reaction caused an increase in WTP. On average, participants' final bids were \$21.08 when they were outbid by another auction participant after 30 seconds and \$28.18 when they were outbid after 10 seconds, and the amount by which competitors outbid them did not qualify this effect (see figure 2).

This pattern of results indicates that the effect on WTP is driven by the speed of competitor reactions to one's bids, and not by how quickly the current high bid in the auction increases. The key contrast that supports this finding is that between the 10 second/\$1 and the 30 second/\$3 condition—the two conditions that were matched in terms of how rapidly the auction's high bid went up, but differed in the speed of competitor reaction. WTP was significantly higher in the 10 second/\$1 condition ( $M = \$27.68$ ) than in the 30 second/\$3 condition ( $M = \$20.83$ ;  $F(1, 74) = 4.00$ ,

$p < .05$ ), pinpointing the speed of competitor reaction as the driving force.

**Perceived Competitive Intensity.** As predicted, participants perceived the auction to be more intensely competitive when the speed at which their bids were reciprocated by others was greater ( $M_{\text{low}} = 4.16$ ,  $M_{\text{high}} = 5.90$ ;  $F(1, 74) = 7.86$ ,  $p < .01$ ), whereas the main effect of competitor bid increment and the interaction between these two factors were not significant (both  $p$  values  $> .6$ ). To examine whether the speed of competitor reaction influenced WTP through the perceived intensity of competition in the auction, we conducted a mediation analysis using the same procedure as in experiment 1. The results show that the indirect effect via perceived competitive intensity is significant ( $a \times b = 4.300$ ), with a 95% confidence interval excluding zero (1.033 to 8.138), whereas the direct path from speed of competitor reaction to WTP is not significant once the indirect effect is accounted for ( $p > .3$ ), indicating a case of indirect-only mediation whereby the speed of competitor reaction influenced WTP entirely via perceived competitive intensity.

## Discussion

The results of experiment 2 show that the positive effect of faster pace on WTP in ascending auctions is driven specifically by the speed of competitor reaction. In particular, WTP is not affected when auctions are instead accelerated by larger competitor bid increments. Indeed, the auctions that involved such jump bids were not perceived to be any more fast-paced or competitive. Moreover, a mediation analysis demonstrates that, in line with our hypothesis, greater speed of competitor reaction increases bidders' WTP for the auctioned product via greater perceived competitive intensity.

One question not fully addressed by the evidence presented thus far is whether the positive effect of the speed of competitor reaction on WTP might reflect bidders' learning about the value of the auctioned product based on the timing of other auction participants' bids. We examine this possibility in experiment 3.

## EXPERIMENT 3

While the evidence presented so far provides strong support for the positive effect of the speed of competitor reaction on consumers' WTP for an auctioned product, it does not fully rule out the possibility that the effect might actually reflect normative bidder behavior. In particular, when product valuations are not independent across prospective buyers (Milgrom and Weber 1982), it can be rational for bidders to draw inferences about their own WTP for the auctioned product in light of others' bidding behavior. Such inferences could be based not only on bid amounts,



but also on how quickly auction participants reciprocate others' bids—in line with a belief that more rapid bidding by other auction participants might signal that they have a higher valuation of the auctioned product (although there is no indication of such an effect in prior theoretical or empirical work).

The primary objective of experiment 3 was to determine whether the positive effect of the speed of competitor reaction on WTP holds even in a setting where the bidding behavior of others is clearly uninformative with respect to participants' valuations of the product they are bidding for. To that end, we developed an ascending auction with an unusual property: each participant in the auction bids for a different, randomly assigned product (see below for details).

An additional objective of this experiment was to more closely examine the psychological mechanism that drives the effect of the speed at which one's bids are surpassed by others on consumers' WTP for an auctioned product by testing whether the positive effect of perceived competitive intensity on WTP is mediated by a greater desire to win the auction.

Finally, we wanted to investigate whether the effect of the speed of competitor reaction on WTP is qualified by the number of bidders. The link between the latter and an auction's competitive intensity is not straightforward: according to economic theory, competition is more intense when the number of bidders is larger (Kagel 1995), whereas a psychological perspective suggests the opposite in that a smaller number of competitors may lead to more intense competitive rivalry (Garcia and Tor 2009; Ku et al. 2005). Thus, while we had no (directional) hypothesis regarding the main effect of the number of bidders, we incorporated this factor to examine whether it moderates the effect of the speed of competitor reaction on WTP.

## Method

The procedure was the same as that for experiment 1, with the exceptions identified below. A total of 208 undergraduate business students participated in the experiment in exchange for research credit. They were randomly assigned to one of eight conditions in a 2 (auctioned product: common to all bidders vs. unique to each bidder)  $\times$  2 (speed of competitor reaction: low vs. high)  $\times$  2 (number of bidders participating in the auction: 10 vs. two) between-subjects design. Before starting the auction, participants had to correctly answer three questions to ensure that they fully understood the instructions regarding the auctioned product and the number of bidders.

The manipulation of the first factor led participants to believe that they participated in one of two types of auctions. The first was a standard ascending auction (as used in the previous experiments) in which a number of bidders compete for the right to purchase a particular product, and

whoever submits the highest bid receives that product in exchange for the successful bid amount. The second type differed from the first in one important respect. Auction participants believed that they had been randomly assigned to *different* products so that each of them bid for a unique item, with no two participants in an auction bidding for the same product. (Participants were informed that the products varied significantly in terms of their retail price.) As in a standard auction, participants bid against each other, and whoever submitted the highest bid purchased whatever unique product she had bid for (in exchange for the successful bid amount). Critically, however, bidders knew only their assigned product; they were blind to the unique products that the other participants were (purportedly) bidding for. In the unique-product conditions, the bidding behavior of others was therefore uninformative with respect to the value of the particular product that a participant was bidding for, and the speed of competing bidders' reactions could not have served as a basis for any inferences about others' valuations of that product. In fact, all participants bid for the same fleece sweater as in the previous experiments.

The speed of competitor reaction was manipulated as in experiment 1, with participants being outbid by \$1 either 30 seconds (slow) or 10 seconds (fast) after their most recent bid. Finally, we manipulated the number of bidders by informing participants that the total number of participants in their auction was either 10 or two—that is, that they were competing against either nine or only one other bidder(s).

Once the auctions had ended, participants completed a brief survey that included the same measures as in experiment 2. In addition, participants were asked to indicate how strong of a desire they felt to win the auction (0 = none, 10 = very strong) and how informative they thought the bidding behavior of other participants in their auction was with respect to the value of the product they were bidding for (0 = not at all informative, 10 = highly informative).

## Results

*Manipulation and Confounding Checks.* As expected, participants believed that the bidding behavior of other auction participants was much more informative with respect to the value of the product they were bidding for when the latter was common to all bidders ( $M = 5.50$ ) rather than unique ( $M = 2.62$ ;  $F(1, 200) = 92.88$ ,  $p < .001$ ), indicating that this manipulation was effective. Neither of the other two manipulated factors had a significant effect on this measure (both  $p$  values  $> .8$ ), nor did any of the interactions (all  $p$  values  $> .7$ ). Moreover, participants perceived the auction to be faster-paced when their bids were reciprocated by another bidder after 10 seconds ( $M = 7.26$ ) than when this occurred after 30 seconds ( $M = 4.78$ ;

$F(1, 200) = 53.49, p < .001$ ). Neither of the other two manipulated factors had a significant effect on the perceived pace of the auction (both  $p$  values  $> .4$ ), nor did any of the interactions (all  $p$  values  $> .5$ ).

**Estimated Retail Price.** None of the manipulations influenced participants' estimates of the retail price of the product they were bidding for ( $M = 61.15$ ; all  $p$  values  $> .6$ ).

**Willingness to Pay.** The results of an ANOVA with participants' WTP for the auctioned product as the dependent variable reveal significant main effects of the speed of competitor reaction ( $F(1, 200) = 10.41, p < .01$ ) and of the number of bidders ( $F(1, 200) = 9.13, p < .01$ ), but no main effect of auctioned product (common vs. unique,  $F(1, 200) = .01, p = .99$ ) and no interaction effects (all  $p$  values  $> .5$ ). As predicted, greater speed of competitor reaction caused a higher WTP. On average, participants' final bids were \$37.36 when other auction participants outbid them with a 10 second delay and \$27.21 with a 30 second delay. Critically, this was not moderated by whether participants believed that they bid for the same product as all other auction participants or for a product that was unique to them. This result shows that the effect of the speed of competitor reaction on WTP persists even when others' bidding behavior is uninformative with respect to the value of the product they are bidding for.

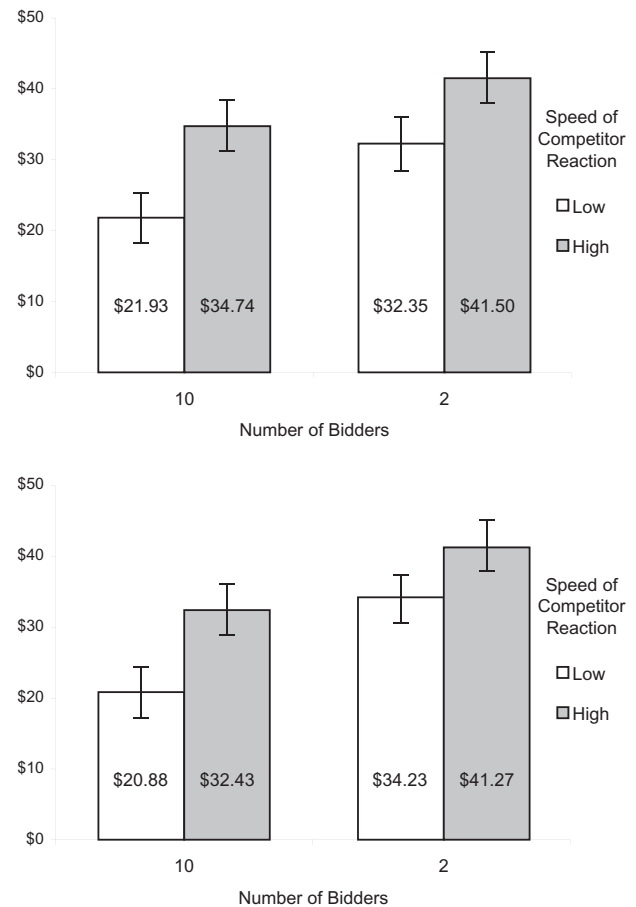
Participants' WTP for the auctioned product was higher when they believed that they participated in an auction with only one other bidder ( $M = \$37.49$ ) than when they believed they were one of 10 bidders ( $M = \$27.66$ ). This effect was not qualified by the speed of competitor reaction or by auction format. The mean WTP values in the eight conditions of experiment 3 are shown in figure 3.

**Perceived Competitive Intensity.** Participants perceived the auction to be more intensely competitive when their bids were surpassed by others more quickly ( $M_{\text{low}} = 4.36, M_{\text{high}} = 6.96; F(1, 200) = 58.51, p < .001$ ), and also when they competed against only one other bidder ( $M_{10\text{bidders}} = 5.04, M_{2\text{bidders}} = 6.40; F(1, 200) = 15.90, p < .001$ ). A significant two-way interaction reveals that the effect of speed of competitor reaction on perceived competitive intensity was somewhat stronger when participants believed they were competing against nine other bidders rather than one ( $F(1, 200) = 8.38, p < .01$ ). However, the main effect of auctioned product (common vs. unique) and all other interaction effects were not significant (all  $p$  values  $> .5$ ).

**Desire to Win.** Participants' desire to win the auction was greater when they were outbid more quickly ( $M_{\text{low}} = 3.80, M_{\text{high}} = 6.08; F(1, 200) = 47.44, p < .001$ ) and when they competed against only one other bidder ( $M_{10\text{bidders}} = 4.45, M_{2\text{bidders}} = 5.53; F(1, 200) = 9.98, p < .01$ ). A significant two-way interaction shows that the

FIGURE 3

WTP BY SPEED OF COMPETITOR REACTION, NUMBER OF BIDDERS, AND AUCTIONED PRODUCT (EXPERIMENT 3)



effect of speed of competitor reaction on the desire to win was somewhat stronger when participants believed they were competing against one other bidder rather than nine ( $F(1, 200) = 9.36, p < .01$ ). However, the main effect of auctioned product (common vs. unique) and all other interaction effects were not significant (all  $p$  values  $> .8$ ).

**Mediation Analyses.** To examine the psychological mechanism that underlies the positive effect of the speed of competitor reaction on WTP, we estimated a sequential mediation model (Hayes 2013) that reflects our prediction that this effect is serially mediated by the perception that the auction is more intensely competitive and by a greater desire to win. The results reveal a significant indirect effect of speed on WTP via these two mediators ( $a_1 \times d_{21} \times b_2 = 5.278$ ), with a 95% confidence interval that excludes zero (3.164 to 8.482), whereas the positive direct effect of speed on WTP is no longer significant once the

indirect effect is accounted for ( $p > .9$ ). Thus, as hypothesized, greater speed of competitor reaction leads bidders to perceive the auction to be more intensely competitive, which heightens their desire to win the auction, in turn increasing their WTP.

The negative main effect of the number of bidders on WTP is also serially mediated by participants' perception of how intensely competitive the auction was and by their desire to win it. The indirect effect via perceived competitive intensity and desire to win is significant ( $a_1 \times d_{21} \times b_2 = -.329$ ), with a 95% confidence interval excluding zero ( $-.594$  to  $-.163$ ), and the direct path from number of bidders to WTP is no longer significant once the indirect effect is accounted for ( $p > .8$ ).

**Bid Latency.** Although our primary focus is on the effect of the speed of competitor reaction on bidders' WTP, in this experiment we also examine the timing of participants' own bids. In line with our account that greater speed of competitors' reactions to one's bids induces a higher level of perceived competitive intensity, we expected that being outbid more rapidly causes bidders to, in turn, reciprocate others' bids more quickly. To test this prediction, we estimated a random coefficient model with the (log-transformed) amount of time in seconds between the most recent prior bid by another auction participant and the submission of a bid by the participant—that is, the "latency" of the latter's bid—as the dependent variable, and with the three manipulated factors along with the serial position of the bid in a participant's sequence of bids (linear and quadratic terms) as independent variables. Thus, the model is

$$\log(BL_{ij}) = \alpha_i + \beta_1 SCR_i + \beta_2 AP_i + \beta_3 NB_i + \beta_4 SP_{ij} + \beta_5 SP_{ij}^2 \quad (1)$$

where  $BL_{ij}$  is the bid latency in seconds for bidder  $i$ 's ( $i = 1, \dots, n$ ) bid  $j$  ( $j = 1, \dots, m_i$ ),  $SCR_i$  is the speed of competitor reaction ( $0 = 30$  second delay,  $1 = 10$  second delay),  $AP_i$  is the nature of the auctioned product ( $0 = \text{common}$ ,  $1 = \text{unique}$ ),  $NB_i$  is the number of bidders in the auction ( $2, 10$ ), and  $SP_{ij}$  is the serial position ( $1, 2, 3, \dots, n_i$ ) in the sequence of bids submitted by the participant, for which we estimated both a linear and quadratic term (to test for nonlinearity in its influence on bid latency). To capture heterogeneity across participants and account for differences in the length of individuals' bid sequences, the estimated model also included a bidder-specific intercept  $\alpha_i$  and random coefficients for the effects of serial position.

This analysis reveals that a higher speed of competitor reaction caused participants to submit their own bids earlier. Participants' bid latency was lower when they were being outbid after 10 seconds ( $M = 11.72$  seconds) than when this occurred after 30 seconds ( $M = 13.79$  seconds;

$\beta_1 = -.198$ ,  $t = 2.58$ ,  $p < .01$ ). The number of bidders in the auction also influenced bid latency, with participants submitting their bids earlier when there was only one competing auction participant ( $M = 11.72$  seconds) than when there were nine other bidders ( $M = 13.75$  seconds;  $\beta_3 = .027$ ,  $t = 2.80$ ,  $p < .01$ ). Finally, while the linear effect of serial position on bid latency ( $\beta_4$ ) was not significant ( $p > .1$ ), the analysis did reveal a nonlinear effect such that participants bid less quickly as they approached their final, highest bid ( $\beta_5 = .001$ ,  $t = 3.11$ ,  $p < .01$ ), suggesting that they engaged in more careful deliberation as the auction's current high bid approached their WTP.

## Discussion

The key finding of this experiment is that the effect of the speed of competitor reaction on WTP cannot be accounted for by bidders' inferences about the market value of the auctioned product based on the timing of other auction participants' bids. Indeed, the effect was just as strong when the bidding behavior of others was completely uninformative with respect to the value of the product that participants were bidding for. (Overall, being outbid after 10 seconds rather than 30 seconds caused an increase in WTP by about 35%.) Moreover, the findings of this experiment deepen our understanding of the forces that govern the positive effect of speed of competitor reaction on WTP by showing that it is serially mediated by increased perceived competitive intensity and a stronger desire to win.

The results of experiment 3 also show that bidding against only one other auction participant results in a higher WTP than does bidding against a larger number of competitors. This is consistent with the notion that strategic bidders might reduce their bids as the number of auction participants increases to avoid a potential winner's curse (Bazerman and Samuelson 1983; Kagel and Levin 1986), as well as with a behavioral account whereby bidders perceive auctions with a smaller number of participants to be more competitive and, as a result, bid more aggressively. The evidence from this experiment provides support for the latter, which is also consistent with Jap and Haruvy's (2008) observation that suppliers bid less aggressively in industrial reverse auctions as the number of bidders increased and with Ku et al.'s (2005) finding that study participants reported higher levels of arousal when they considered a scenario in which they faced a smaller number of competing bidders.

Given the current work's focus on the effect of how quickly consumers are outbid by competing auction participants on their WTP, the primary reason for manipulating the number of bidders in this experiment was to examine whether the effect of the speed of competitor reaction is moderated by how many other bidders a consumer is competing against. The results clearly indicate that this is not the case. Being outbid more quickly resulted in a

substantial increase in WTP, and it did so irrespective of whether participants were competing against one or nine other auction participants. Thus, the number of bidders and the speed of competitor reaction each influence WTP, but they do so independently.

The results of experiment 3 provide insight into how the speed of competitor reaction influences not only auction participants' WTP, but also the timing of their own bids. Our bid-latency analysis reveals that being outbid more quickly causes consumers to, in turn, place their own bids sooner. This sheds some light onto the dynamics of consumer-to-consumer interaction in ascending auctions, suggesting that an increase in the speed at which competing auction participants place their bids can be mutually reinforcing. The bid-latency results also speak to the possibility that bidders might have a lay theory about the connection between a competing bidder's WTP and the timing of her bids. If our participants had such a lay theory, they should have also used it to regulate their own bidding behavior. In particular, if auction participants believed that greater bidding speed signals a higher WTP, they should strategically delay their own bids so as to avoid signaling that they might be prepared to bid a large amount. The bidding behavior we observed in experiment 3 is inconsistent with such an account, as greater speed of competitor reaction actually caused participants to bid *more* quickly themselves, which is the opposite of what they should have done to avoid signaling a high WTP. Overall, the timing of participants' bids does not suggest any intention on their part to strategically slow down the auctions. On average, they used up only about a third of the time window for submitting their bids. That is, they failed to take advantage of the available opportunities to delay their bids (and to thus signal that their WTP is low).

In this experiment, we have demonstrated that greater speed of competitor reaction causes a higher WTP by increasing the auction's perceived competitive intensity, even in the absence of any possibility that bidders might draw inferences about the value of the particular product they are bidding for based on the timing of others' bids. Thus, we have been able to pinpoint the nature of the effect of speed of competitor reaction on consumers' WTP for an auctioned product as being linked specifically to the perceived intensity of the competitive interaction with other bidders, and as distinct from any inferences about the auctioned product's market value that could be accounted for by a normative model of bidding behavior.

Another key step in deepening our understanding of this phenomenon is to probe what is *necessary* for the effect of speed of competitor reaction to occur. Our account of the phenomenon suggests that direct competitive interaction with other human bidders is essential. We test this hypothesis in experiment 4.

## EXPERIMENT 4

To examine whether direct interaction with other human bidders is a necessary condition for the positive effect of speed of competitor reaction on auction participants' WTP, experiment 4 employed an auction format that does not involve such interaction. In particular, participants participated in an ascending auction that was identical to those used in the previous experiments, with the critical difference that they were (truthfully) informed that they were interacting with a *bidding machine* rather than other human auction participants. Prior research suggests that people may behave differently when bidding against computerized actors rather than other human bidders (Adam et al. 2015; Van den Bos et al. 2008).

Participants were told that the bidding machine was programmed to behave according to a specific protocol, which included the timing of its bids. Thus, it was clear to participants that the speed at which the machine outbid them had been determined in advance by the researchers. In addition to the speed of competitor reaction, we also manipulated participants' beliefs about whether or not the bidding machine acted on behalf of another human. Our expectation was that competing against a machine that represents a human principal (who participates in the auction via the bidding machine as her "agent") might result in a higher WTP than competing against a disinterested machine.

## Method

Participants individually participated in an ascending auction along with a bidding machine that reciprocated their bids. Participants were informed that the bidding machine had been programmed to outbid them by \$1 at a time up to a prespecified amount that was unknown to them (see below) and that, once the auction's high bid had reached that amount, the machine would stop reciprocating, rendering the participant the winner of the auction. Once 60 seconds had passed without a new bid being submitted by either the participant or the bidding machine, the auction ended. In fact, as in the previous experiments, the bidding machine was programmed to continue to outbid participants until they ceased to submit bids. Thus, the auction concluded as soon as there were 60 seconds of inaction on the part of the participant following a bid by the machine.

Apart from the fact that participants knew that they interacted with a bidding machine instead of human bidders, the procedure was the same as in the previous experiments. A total of 109 undergraduate business students participated in the experiment in exchange for research credit. They were randomly assigned to one of four conditions in a 2 (speed of competitor reaction: low vs. high)  $\times$  2 (bidding machine acting on behalf of a human principal:



yes vs. no) between-subjects design. To proceed to the auction, participants had to pass a thorough test of comprehension to ensure that they fully understood the instructions.

The speed of competitor reaction was manipulated as in experiment 3, with the machine's bids—exceeding the previous high bids by \$1—arriving with a delay of either 30 seconds (low speed) or 10 seconds (high speed) following the most recent bid by the participant.

To manipulate participants' beliefs as to whether the bidding machine was acting on behalf of a human principal, we provided the following task instructions. In the human-principal conditions, participants were informed that they had been matched with one other participant, and that the two of them were to compete against each other in the auction. However, instead of interacting with the participant directly, the other individual (the principal) was represented by a computer program that would place bids on her behalf. The program would do so up to the maximum bid amount that its human principal had specified in advance.

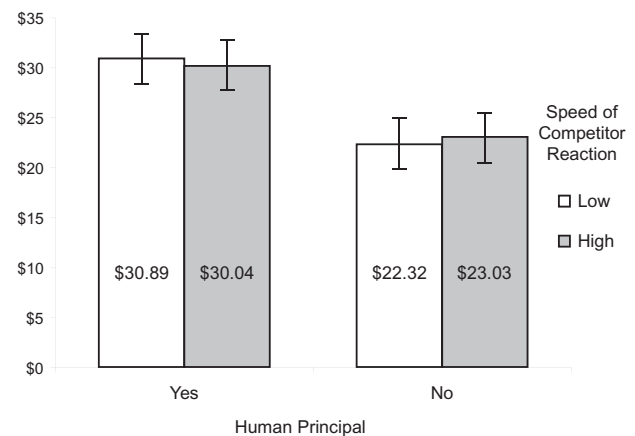
By contrast, in the no-human-principal conditions, participants were told that they were merely bidding against a computer program, and that no other human was involved in the auction. They were informed that this program had a built-in algorithm for determining when it would stop reciprocating their bids. Participants were told that this algorithm would select the computer program's maximum bid amount as follows. For the increasing series of integer amounts (\$1, \$2, \$3, etc.), starting with \$1, it would either select the current amount as the maximum bid with probability .03 or proceed to the next amount with probability .97, and it would repeat this until an amount was selected as the program's maximum bid amount. The test of comprehension that participants had to pass before starting the auction included questions about this algorithm. (As described to participants, this algorithm implies a geometric probability distribution for the program's maximum bid amount with an expected value of \$33.33, a standard deviation of \$32.83, and no upper bound.)

After the conclusion of the auction, participants completed the same set of measures that was used in experiment 2.

## Results

**Manipulation and Confounding Checks.** As expected, participants perceived the auction to be more fast-paced when their bids were reciprocated after 10 seconds ( $M = 6.04$ ) than when this occurred after 30 seconds ( $M = 4.11$ ;  $F(1, 105) = 15.21$ ,  $p < .001$ ), confirming that the manipulation of the speed of competitor reaction was effective. Neither the manipulation of whether the amount at which the bidding machine would stop reciprocating

**FIGURE 4**  
WTP BY SPEED OF COMPETITOR (BIDDING MACHINE) REACTION AND WHETHER THE BIDDING MACHINE ACTS ON BEHALF OF A HUMAN (EXPERIMENT 4)



participants' bids was determined by a human principal or at random ( $p > .9$ ) nor its interaction with the speed of competitor reaction ( $p > .2$ ) had a significant effect on the perceived pace of the auction.

**Estimated Retail Price.** The manipulations of the speed competitor reaction and of whether the bidding machine was described as acting on behalf of a human principal did not influence participants' estimates of the auctioned product's retail price ( $M = 61.34$ ; all  $p$  values  $> .7$ ).

**Willingness to Pay.** The results of an ANOVA with bidders' WTP for the auctioned product as the dependent variable indicate the *absence* of an effect of the speed of competitor reaction ( $M_{\text{low}} = \$26.41$ ,  $M_{\text{high}} = \$26.85$ ;  $F(105, 1) = .01$ ,  $p > .9$ ). However, they do reveal that WTP was higher when participants believed that the bidding machine was acting on behalf of a human principal ( $M_{\text{HP}} = 30.47$ ) than when this was not the case ( $M_{\text{noHP}} = 22.70$ ;  $F(105, 1) = 4.27$ ,  $p < .05$ ). This effect was not qualified by the speed of competitor reaction ( $F(105, 1) = .03$ ,  $p > .8$ ). Figure 4 shows the mean WTP in the four conditions of experiment 4.

**Perceived Competitive Intensity.** The manipulations of the speed competitor reaction and of whether the bidding machine was described as acting on behalf of a human principal did not affect participants' perception of how competitive the auction was ( $M = 4.30$ ; all  $p$  values  $> .6$ ).

**Joint Analysis of Data from Experiments 3 and 4.** Since the data for experiments 3 and 4 were collected simultaneously with samples drawn from the same participant population, it is reasonable to jointly analyze

the two conditions of experiment 3 that are the natural points of comparison for experiment 4 (i.e., the common-product conditions with one competing bidder) and treat them as part of a  $2 \times 2$  design together with the two human-principal conditions of experiment 4. An ANOVA with WTP as the dependent variable reveals a significant interaction between human versus machine and speed of competitor reaction ( $F(103, 1) = 3.95$ ,  $p < .05$ ) such that greater speed of competitor reaction increases WTP when participants are bidding directly against another human, but that it has no such effect when they are bidding against a machine who acts on behalf of a human principal.

## Discussion

The results of experiment 4 sharpen our understanding of how the speed of competitor reaction in an ascending auction influences bidders' WTP. They do so by identifying a key boundary condition of this phenomenon—that direct competitive interaction with other humans is a necessary condition for the effect to occur. Once this element of the auction experience is removed, being outbid more quickly (e.g., by a software agent) no longer causes an increase in WTP.

Bidders' WTP was influenced considerably by whether the bidding machine that they were interacting with was (ostensibly) acting on behalf of a human principal. Competing against another person, albeit via a computer-mediated protocol, for the right to purchase a product resulted in a substantially higher WTP than competing against a disinterested machine.

## EXPERIMENT 5

The objective of experiment 5 was to shed further light on the psychological mechanism that underlies the effect of the speed of competitor reaction on bidding behavior. In addition to aiming to corroborate insights from the previous experiments, we examined whether the perception of competitive intensity in connection with an auction is indeed distinct from what has been termed “competitive arousal” in prior work (Ku et al. 2005; Malhotra 2010), and we sought to confirm that the manipulation of the speed of competitor reaction used in the present research has no unintended side effects on bidders' perception of time pressure and on any inferences they might make about the number of competing bidders.

The total number of bidders participating in an auction was stated explicitly in each of the earlier experiments (and manipulated in one of them). Consequently, the effects of the speed of competitor reaction on WTP that we observed there cannot be due to inferences about the number of bidders. However, in the wild, auction participants may not know the actual number of competing bidders,

and it is worth examining what, if anything, participants infer about the number of bidders based on the speed of competitor reaction in such instances. Thus, we did not provide participants with any information about the number of bidders in experiment 5.

## Method

A scenario-based approach (similar to that employed by Ku et al. 2005 and Malhotra 2010) was used in this experiment. Participants read the description of a bidding situation (see appendix B for details) and were asked to imagine the following. They are actively bidding in a live auction for an item that they would like to buy, and they had decided in advance that the most they would be willing to pay for this item was approximately \$150. The auctioneer was going to end the auction once 30 seconds had passed without anybody submitting a bid and, at that point, the product would be awarded to whoever had placed the highest bid. Participants' most recent bid was \$145. Another auction participant just bid \$150, and participants now had to decide whether to continue bidding by submitting a bid of \$155.

Participants were presented with a table showing the bidding history for the auction, from \$100 to the current high bid of \$150, in \$5 increments. For each of these bids, the table included the amount of time (in seconds) that had passed since the previous bid—that is, the speed of competitor reaction in the auction.

A total of 306 undergraduate business students completed the experiment remotely via the internet in exchange for monetary compensation. They were randomly assigned to one of two experimental conditions that differed in the speed at which bids had been reciprocated in the auction. In the *low speed of competitor reaction* condition, an average of 15 seconds had passed since the previous bid. By contrast, in the *high speed of competitor reaction* condition, bids had arrived an average of 3 seconds apart (see appendix B).

After reading the description of the situation and reviewing the bidding history of the auction, participants were asked to indicate how likely they would be to place another bid in the auction (on a continuous scale with endpoints 0% = “definitely *will not* make another bid” and 100% = “definitely *will* make another bid”). They then proceeded to answer a series of additional questions about the auction. As in all previous experiments, we measured the perceived competitive intensity of the auction by asking participants to indicate how intense they thought the competition was among bidders in the auction (0 = not at all intense, 10 = extremely intense). We also used an additional three-item scale to measure perceived competitive intensity: “I felt that the auction was highly competitive,” “competition in the auction was cut-throat,” and “bidder rivalry in the auction was fierce”

(1 = strongly disagree, 7 = strongly agree).<sup>2</sup> Moreover, participants indicated their desire to win the auction ("I felt a strong desire to win the auction," 1 = strongly disagree, 7 = strongly agree) and their perception of how fast-paced the auction was ("I felt that the auction was very fast-paced," 1 = strongly disagree, 7 = strongly agree). In addition, following Ku et al. (2005), we measured competitive arousal using two items: how excited and how anxious participants felt about the auction (1 = not at all, 11 = very much). We measured participants' mood associated with the auction using three items (adapted from Mano and Oliver 1993): "in a good mood," "happy," and "elated" (1 = not at all, 11 = very much). Next, participants were asked to estimate how many bidders participated in the auction. Finally, we used a three-item scale (based on Putrevu and Ratchford 1997) to measure perceived time pressure in connection with the auction: "I found myself pressed for time," "I felt in a hurry," and "I had only a limited amount of time to decide" (1 = strongly disagree, 7 = strongly agree).

## Results

**Manipulation Checks.** Participants perceived the auction to be more fast-paced when bids arrived an average of 3 seconds apart ( $M = 5.39$ ) than when then this occurred about every 15 seconds ( $M = 4.07$ ;  $F(1, 306) = 15.78$ ,  $p < .001$ ), confirming that the manipulation of the speed of competitor reaction was effective.

**Mood.** The three items used to measure mood were combined into a single measure (Cronbach's  $\alpha = .89$ ). The manipulation of the speed of competitor reaction did not have any effect on participants' mood ( $M_{\text{low}} = 6.62$ ,  $M_{\text{high}} = 6.73$ ;  $F(1, 306) = .23$ ,  $p = .64$ ).

**Likelihood of Continuing to Bid.** The results of an ANOVA with the likelihood of continuing to bid as the dependent variable support our hypothesis that greater speed of competitor reaction increases the willingness to continue bidding ( $M_{\text{low}} = 65.68\%$ ,  $M_{\text{high}} = 72.49\%$ ;  $F(1, 306) = 5.30$ ,  $p = .022$ ). In addition, a more favorable mood resulted in a greater likelihood of continuing to bid ( $F(1, 306) = 14.03$ ,  $p < .001$ ). However, since the speed of competitor reaction had no impact on mood, the latter's effect on propensity to bid reflects an exogenous (rather than a mediational) influence.

**Inferences about the Number of Competing Bidders.** The speed of competitor reaction did not have a significant effect on participants' estimates of how many

bidders participated in the auction ( $M_{\text{low}} = 10.80$ ,  $M_{\text{high}} = 13.80$ ;  $F(1, 306) = 3.24$ ,  $p < .107$ ). The observed mean estimates suggest that, if anything, greater speed of competitor reaction led participants to infer that there were more competing bidders, thus clearly ruling out the possibility that speed might have increased the motivation to continue bidding via a reduction in the perceived number of competing bidders.

**Perceived Time Pressure.** The three items used to measure perceived time pressure were combined into a single measure (Cronbach's  $\alpha = .88$ ). The speed of competitor reaction did not affect perceived time pressure ( $M_{\text{low}} = 4.86$ ,  $M_{\text{high}} = 5.01$ ;  $F(1, 306) = 1.92$ ,  $p < .339$ ), and the latter had no impact on the likelihood of continuing to bid ( $F(1, 306) = .07$ ,  $p = .79$ ). This indicates that the effect of speed of competitor reaction on the inclination to continue bidding is distinct from any impact that time pressure might have, and that participants did not misconstrue a more rapid interchange of bids as implying greater time pressure for bidders.

**Perceived Competitive Intensity.** Since the results are qualitatively the same irrespective of whether the single-item or the three-item (Cronbach's  $\alpha = .78$ ) measure of perceived competitive intensity is used (correlation between the two:  $\rho = .769$ ), we report those based on the single-item measure for consistency with the other experiments. In line with our theorizing, participants perceived the auction to be more competitive when the arrival rate of the bids by competing auction participants was higher ( $M_{\text{low}} = 4.46$ ,  $M_{\text{high}} = 5.09$ ,  $F(1, 306) = 7.26$ ,  $p < .01$ ).

**Competitive Arousal.** Following Ku et al. (2005), we combined the two measures of competitive arousal into a single scale (which, consistent with what Ku et al. found, has very poor psychometric properties: Cronbach's  $\alpha = .44$ ; Pearson correlation = .30). Tests of discriminant validity indicate that competitive arousal and perceived competitive intensity are distinct constructs. First, a comparison of confirmatory-factor-analysis models with either one or two factors shows that, according to a chi-square difference test (Bagozzi, Yi, and Phillips 1991), the two-factor model is superior to the single-factor model ( $\chi^2_{\Delta}(1) = 10.17$ ,  $p < .01$ ). Following Fornell and Larcker (1981), discriminant validity is also indicated by the result that the constructs' average variance extracted (AVE = .756) is greater than the squared correlation of the two constructs ( $\rho^2 = .160$ ). Moreover, unlike perceived competitive intensity, competitive arousal was *not* affected by the speed of competitor reaction ( $M_{\text{low}} = 7.28$ ,  $M_{\text{high}} = 6.99$ ;  $F(1, 306) = 1.55$ ,  $p > .2$ ). Competitive arousal and perceived competitive intensity were only weakly positively correlated ( $\rho = .423$  and  $\rho = .403$  for the single- and three-item measures of perceived competitive intensity, respectively).

2 The item "competition in the auction was cut-throat" was adapted from a measure used by Jaworski and Kohli (1993), and the item "bidder rivalry in the auction was fierce" was based on Porter (2008), who defines the intensity of rivalry among competitors in an industry as the extent to which firms put pressure on one another and limit one another's profit potential.

*Desire to Win.* Greater speed of competitor reaction led to a more intense desire to win the auction ( $M_{\text{low}} = 4.97$ ,  $M_{\text{high}} = 5.24$ ;  $F(1, 306) = 5.46$ ,  $p < .01$ ).

*Mediation Analyses.* To examine the psychological mechanism through which the speed of competitor reaction influenced the likelihood of continuing to bid, we estimated a mediation model in which this effect is serially mediated by the auction's perceived competitive intensity and by a greater desire to win. The results reveal a significant indirect effect of speed on bidding via these two mediators ( $a_1 \times d_{21} \times b_2 = 3.272$ ), with a 95% confidence interval excluding zero (1.540 to 5.573), whereas the direct path from speed to likelihood of continuing to bid is no longer significant once the indirect effect is accounted for ( $p > .5$ ). Thus, greater speed of competitor reaction leads to the perception of greater competitive intensity, which intensifies the desire to win the auction, in turn increasing the inclination to continue bidding.

## Discussion

The results of experiment 5 complement those of the earlier experiments by providing deeper insight into the psychological mechanism underlying the influence of the speed of competitor reaction on consumer bidding behavior in auctions. First, they provide a conceptual replication of the finding that the speed of competitor reaction influences bidding behavior, and that this effect is serially mediated by the perception of increased competitive intensity and a greater desire to win. Moreover, the results of this experiment demonstrate that perceived competitive intensity is distinct from the construct of competitive arousal that has been examined in prior work on auctions, albeit not on the role of the speed of competitor reaction (Ku et al. 2005; Malhotra 2010). The two constructs were only weakly positively correlated. Importantly, while speed of competitor reaction had a positive impact on perceived competitive intensity, it had no effect on competitive arousal. In addition, the findings show that the speed of competitor reaction does not influence bidders' mood. Finally, this experiment provides clear evidence that the speed of competitor reaction is independent of the amount of time pressure that consumers might experience in connection with an auction, and of any inferences consumers might make about the number of competing bidders.

## GENERAL DISCUSSION

Competition among bidders is an essential aspect of auctions (Ariely and Simonson 2003; Milgrom and Weber 1982). Therefore, developing a deeper understanding of how such competition affects bidding behavior is important from both a theoretical and a practical standpoint. The present research has focused on one key aspect of the

competitive interaction among bidders in ascending auctions: the speed of competitor reaction. Our central hypothesis was that being outbid more quickly by other auction participants causes bidders to perceive an auction as more intensely competitive, resulting in a greater desire to win, and ultimately in a willingness to pay more for the auctioned product.

Evidence from five experiments provides strong support for this hypothesis. Moreover, the findings pinpoint a number of other essential aspects of the psychological mechanism that underlies the positive effect of the speed of competitor reaction on consumers' WTP for an auctioned product, and they rule out several potential alternative explanations. First, the results show that the effect is caused specifically by the rate of arrival of other auction participants' bids, and not by the auction's duration or overall rate of progression, nor by bidders' perception of time pressure. Moreover, our findings demonstrate that the effect of speed of competitor reaction on bidding behavior is not driven by bidders' inferences about the number of competing auction participants, or about the auctioned product's market value, based on the arrival rate of bids. In addition, the results presented here show that being outbid more quickly increases WTP for the auctioned product irrespective of the number of bidders participating in an auction. Finally, we have identified direct competitive interaction with other bidders as a necessary condition for the effect by showing that being outbid more quickly increases WTP only when the speed at which this occurs reflects the decision of a human competitor in the heat of the moment (rather than a prespecified protocol that is automatically executed by a machine).

The findings presented in this article contribute to an emerging body of literature on bidding behavior in auctions (Bagchi and Cheema 2013; Cheema, Chakravarti, and Sinha 2012; Kamins et al. 2004; Popkowski Leszczyc and Rothkopf 2010; Spann et al. 2012). In particular, they reveal a key mechanism by which the dynamic interaction among competing bidders that is inherent to ascending auctions affects consumers' bidding behavior. While the importance of the competitive dynamics in auctions has been recognized in prior work, that research focused on the role of the number of bids placed in an auction (Heyman et al. 2004) and on the effects of the number of bidders and of the amount of time remaining in an auction (Ku et al. 2005). The unique contribution of the present research is that it sheds light on how the *speed of competitor reaction* influences bidding behavior.

The findings from the current set of experiments, in combination with those reported by Ku et al. (2005) and Malhotra (2010), show that some aspects of an auction tend to trigger affective responses like competitive arousal, while others influence inferential judgments like perceived competitive intensity (as shown in this article). Both perceived competitive intensity and competitive arousal



enhance the desire to win and result in increased bidding, but they represent distinct psychological forces. Moreover, they are ignited by different antecedents: perceived competitive intensity is driven by the speed of competitor reaction, while competitive arousal is a function of time pressure and the number of bidders. (We found that the number of bidders can also influence perceived competitive intensity, but this is distinct from the effect of the speed of competitor reaction.) Further research is needed to deepen our understanding of the psychological forces that govern bidding behavior in competitive settings, particularly of how other aspects of auctions map onto affective responses versus inferential judgments.

An important feature of the present work is that it employed an innovative experimental paradigm that allowed us to (1) manipulate the speed of competitor reaction in an ascending auction setting and (2) treat the individual consumer participating in an auction—rather than an entire auction—as the unit of analysis. The key benefit of directly manipulating the speed at which participants' bids were surpassed by others is that this enabled us to isolate the effect that is driven specifically by the speed of competitor reaction while controlling for any other factors that it might be correlated with in the wild (e.g., the number of bidders). Compared to the standard approach of treating the auction as the unit of analysis, being able to observe the bidding behavior of each individual participant paved the way for a much more fine-grained examination of, and more conclusive insights into, the psychological mechanism that underlies the effect of the speed of competitor reaction on bidding behavior in auctions.

While the present work significantly advances our understanding of how the dynamics of the competitive interaction among consumers influences bidding behavior in ascending auctions, we can envision several promising avenues for further research in this domain. First, it would be worth investigating whether the effect of the speed of competitor reaction on consumers' WTP for an auctioned product is robust to whether the auction's ending rule (Roth and Ockenfels 2002) is soft (i.e., the auction ends as soon as a prespecified period of time has passed without a

new bid being placed, as in the current experiments) or hard (i.e., the auction ends at a prespecified point in time). Moreover, the effect might be moderated by what consumers know about competing bidders, such as how similar or different they are (Norton, Lamberton, and Naylor 2013). In addition, it would be interesting to examine to what extent the effect generalizes across different types of auctioned products (e.g., experiences vs. material goods, or one-of-a-kind vs. mass-produced items). For instance, the speed of competitor reaction might have a stronger influence on bidding behavior when the auctioned product is unique. And finally, future research could investigate whether the competitive intensity of the bidding process has downstream consequences for how much successful bidders value or enjoy products they acquired in auctions, as well as for other post-acquisition outcomes.

In light of the growing prevalence of ascending auctions as an alternative to posted-price selling, it is important to illuminate the psychological forces that govern consumer bidding behavior in such auctions. In contrast to posted-price markets, where consumers are price takers and deal only with sellers, auctions have the distinct property that prices—and indeed opportunities to buy—are negotiated in a contest with other prospective buyers. Thus, rigorous research into the nature and consequences of the competitive interaction among consumers is needed. By shedding light on how the speed of competitor reaction influences bidding behavior, the findings presented in this article constitute a step toward a deeper understanding of the psychology of bidding in auctions.

## DATA COLLECTION INFORMATION

The data for experiments 1–4 were collected in the behavioral research lab at the University of Alberta School of Business by both authors between January 2002 and April 2003, with some support provided by graduate research assistants, and analyzed jointly by both authors. The data for experiment 5 were collected remotely via the internet in March 2014 by the two authors and analyzed primarily by the second author in close consultation with the first author.

APPENDIX A  
MEANS (AND STANDARD DEVIATIONS) BY CONDITION ACROSS EXPERIMENTS

	Willingness to pay	Number of bids by participant	Bid latency	Bid increment	Perceived competitive intensity	Estimated retail price	Desire to win	N
Experiment 1								
Low speed	24.05 (14.03)	8.29 (5.23)			5.79 (2.35)	57.86 (22.17)		62
High speed	29.57 (14.67)	9.25 (5.45)			6.63 (2.55)	59.22 (22.19)		60
Experiment 2								
\$1 increment, low speed	21.30 (13.08)	7.15 (4.23)			4.05 (3.61)	68.53 (44.26)		20
\$1 increment, high speed	27.68 (12.79)	6.19 (3.17)			5.55 (1.84)	65.55 (30.72)		22
\$3 increment, low speed	20.83 (10.51)	4.11 (2.59)			4.28 (3.03)	54.37 (20.26)		18
\$3 increment, high speed	28.78 (10.51)	4.50 (2.33)			6.01 (2.34)	69.65 (32.93)		21
Experiment 3								
Common, two bidders, low speed	32.35 (23.19)	12.00 (6.45)	13.50 (11.06)	1.81 (1.55)	5.78 (2.50)	61.35 (24.58)	3.87 (2.47)	23
Common, two bidders, high speed	41.50 (26.07)	15.35 (6.79)	11.46 (11.17)	1.81 (1.98)	7.23 (2.30)	59.42 (28.82)	7.27 (2.36)	26
Common, 10 bidders, low speed	21.93 (18.79)	8.08 (5.59)	16.18 (14.12)	1.62 (1.40)	3.37 (2.46)	62.59 (23.71)	3.74 (2.25)	27
Common, 10 bidders, high speed	34.74 (30.12)	10.37 (5.12)	12.22 (11.64)	2.40 (2.71)	6.81 (2.56)	61.04 (30.06)	5.11 (2.97)	27
Random, two bidders, low speed	34.23 (16.61)	13.85 (6.27)	11.95 (11.14)	1.61 (1.31)	5.38 (2.17)	61.27 (23.66)	3.70 (2.29)	26
Random, two bidders, high speed	41.27 (25.14)	16.19 (8.15)	10.61 (11.01)	1.66 (1.25)	7.12 (2.63)	62.31 (23.46)	7.04 (2.07)	26
Random, 10 bidders, low speed	20.88 (18.24)	9.00 (7.88)	14.51 (12.96)	1.55 (1.30)	3.04 (2.30)	60.72 (25.77)	3.84 (2.29)	25
Random, 10 bidders, high speed	32.43 (27.40)	13.29 (9.37)	12.86 (11.96)	1.59 (1.22)	6.71 (2.65)	60.54 (26.92)	5.04 (2.55)	28
Experiment 4								
Machine-human, low speed	30.04 (19.90)	12.07 (7.43)	12.86 (9.69)	1.97 (1.91)	4.52 (2.59)	61.30 (23.31)	3.52 (2.17)	25
Machine-human, high speed	30.89 (26.59)	11.29 (8.38)	12.57 (11.91)	1.57 (1.46)	4.36 (2.66)	59.43 (29.10)	3.29 (1.92)	28
Machine-no human, low speed	23.03 (13.37)	10.14 (5.59)	10.52 (8.72)	1.70 (1.58)	4.10 (2.65)	61.72 (19.47)	2.07 (1.93)	29
Random-no human, high speed	22.32 (15.88)	8.72 (4.73)	11.61 (10.53)	1.33 (.94)	4.24 (2.22)	63.08 (33.19)	1.96 (1.51)	27
Experiment 5								
	Continuing to bid (%)				Perceived competitive intensity		Desire to win	N
Low speed	65.68 (27.46)				4.07 (1.21)		4.79 (1.50)	141
High speed	72.49 (24.97)				4.51 (1.25)		5.24 (1.41)	165

## APPENDIX B

## EXPERIMENT 5: TASK INSTRUCTIONS AND MANIPULATION

## Auction scenario

Imagine that you are attending a live auction and the item up for bid is something that you really, really want. It is the only item of its kind at this auction, and you don't think that you will find this item anywhere else. In fact, because you were waiting to see the item for sale one day, you made it a point to come to this auction. Before bidding began, you had decided that the most you would be willing to pay for this item is approximately \$150. Of course, you'd like to pay as little as possible.

The auctioneer will end the auction as soon as about 30 seconds have passed without anybody submitting a bid. (At that point, the product will be awarded to whoever placed the highest bid.)

You have been actively bidding in the auction, which had a fast [slow] pace (with about 3 [15] seconds between bids), and the price went up quickly [slowly].

Below is part of the bidding history for this auction, which is currently in progress.

## Between-Subjects Manipulation

## Low Speed of Competitor Reaction

Bid Amount	Time Since Previous Bid
\$100	15 sec.
\$105	16 sec.
\$110	15 sec.
\$115	14 sec.
\$120	15 sec.
\$125	15 sec.
\$130	16 sec.
\$135	14 sec.
\$140	16 sec.
\$145	14 sec.
\$150	15 sec.
?	

## High Speed of Competitor Reaction

Bid Amount	Time Since Previous Bid
\$100	3 sec.
\$105	4 sec.
\$110	3 sec.
\$115	2 sec.
\$120	3 sec.
\$125	3 sec.
\$130	4 sec.
\$135	2 sec.
\$140	4 sec.
\$145	2 sec.
\$150	3 sec.
?	

Your most recent bid was \$145. Another bidder just bid \$150. You now have to decide whether you want to continue bidding. Your next bid would be \$155.

How likely are you to place another bid?

definitely **will not** make another bid    0%    .....    100%    definitely **will** make another bid

## REFERENCES

- Adam, Marc T. P., Jan Krämer, and Marius B. Müller (2015), "Auction Fever! How Time Pressure and Social Competition Affect Bidders' Arousal and Bids in Retail Auctions," *Journal of Retailing*, 91 (3), 468–85.
- Allport, Floyd H. (1924), *Social Psychology*, New York: Houghton Mifflin.
- Ariely, Dan, George Loewenstein, and Drazen Prelec (2003), "Coherent Arbitrariness: Stable Demand Curves Without Stable Preferences," *Quarterly Journal of Economics*, 118 (1), 73–106.
- Ariely, Dan and Itamar Simonson (2003), "Buying, Bidding, Playing, or Competing? Value Assessment and Decision Dynamics in Online Auctions," *Journal of Consumer Psychology*, 13 (2), 113–23.
- Astor, Philipp J., Marc T. P. Adam, Caroline Jähmig, and Stefan Seifert (2013), "The Joy of Winning and the Frustration of Losing: A Psychophysiological Analysis of Emotions in First-Price Sealed-Bid Auctions," *Journal of Neuroscience, Psychology, and Economics*, 6 (1), 14–30.
- Avery, Christopher (1998), "Strategic Jump Bidding in English Auctions," *Review of Economic Studies*, 65 (2), 185–210.
- Bagchi, Rajesh and Amar Cheema (2013), "The Effect of Red Background Color on Willingness-to-Pay: The Moderating Role of Selling Mechanism," *Journal of Consumer Research*, 39 (5), 947–60.
- Bagozzi, Richard P., Youjae Yi, and Lynn W. Phillips (1991), "Assessing Construct Validity in Organizational Research," *Administrative Science Quarterly*, 36 (3), 421–58.
- Bajari, Patrick and Ali Hortaçsu (2004), "Economic Insights from Internet Auctions," *Journal of Economic Literature*, 42 (2), 457–86.
- Balague, Gloria (2009), "Competition," in *Performance Psychology in Action*, ed. Kate F. Hays, Washington DC: American Psychological Association, 161–79.
- Bazerman, Max H. and William F. Samuelson (1983), "I Won the Auction but Don't Want the Prize," *Journal of Conflict Resolution*, 27 (4), 618–34.
- Beersma, Bianca, John R. Hollenbeck, Stephen E. Humphrey, Henry Moon, Donald E. Conlon, and Daniel R. Ilgen (2003), "Cooperation, Competition, and Team Performance: Toward a Contingency Approach," *Academy of Management Journal*, 46 (5), 572–90.
- Chan, Tat Y., Vrinda Kadiyali, and Young-Hoon Park (2007), "Willingness to Pay and Competition in Online Auctions," *Journal of Marketing Research*, 44 (2), 324–33.
- Cheema, Amar, Dipankar Chakravarti, and Atanu R. Sinha (2012), "Bidding Behavior in Descending and Ascending Auctions," *Marketing Science*, 31 (5), 779–800.
- Cheema, Amar, Peter T. L. Popkowski Leszczyc, Rajesh Bagchi, Richard Bagozzi, James Cox, Utpal Dholakia, Eric Greenleaf, Amit Pazgal et al. (2005), "Economics, Psychology, and Social Dynamics of Consumer Bidding in Auctions," *Marketing Letters*, 16 (3–4), 401–13.
- Cramton, Peter (1998), "Ascending Auctions," *European Economic Review*, 42 (3–5), 745–56.
- Delgado, Mauricio R., Andrew Schotter, Erkut Y. Ozbay, and Elizabeth A. Phelps (2008), "Understanding Overbidding: Using the Neural Circuitry of Reward to Design Economic Auctions," *Science*, 321 (5897), 1849–52.
- Deutsch, Morton (1949), "A Theory of Co-operation and Competition," *Human Relations*, 2 (2), 129–52.
- Easley, Robert F. and Rafael Tenorio (2004), "Jump Bidding Strategies in Internet Auctions," *Management Science*, 50 (10), 1407–19.
- Fehr, Ernst and Klaus M. Schmidt (1999), "A Theory of Fairness, Competition, and Cooperation," *Quarterly Journal of Economics*, 114 (3), 817–68.
- Fishbach, Ayelet, Janina Steinmetz, and Yanping Tu (2016), "Motivation in a Social Context: Coordinating Personal and Shared Goal Pursuits with Others," in *Advances in Motivation Science*, Vol. 3, ed. Andrew J. Elliot, Cambridge, MA: Academic Press, 35–79.
- Fornell, Claes and David F. Larcker (1981), "Evaluating Structural Equation Models with Unobservable Variables and Measurement Error," *Journal of Marketing Research*, 18 (1), 39–50.
- Garcia, Stephen M. and Avshalom Tor (2009), "The N-Effect: More Competitors, Less Competition," *Psychological Science*, 20 (7), 871–7.
- Haile, Phillip A. and Elie Tamer (2003), "Inference with an Incomplete Model of English Auctions," *Journal of Political Economy*, 111 (1), 1–51.
- Häubl, Gerald and Peter T. L. Popkowski Leszczyc (2003), "Minimum Prices on Product Valuations in Auctions," *Marketing Science Institute Reports*, Issue 3, Working Paper No. 03-117, 115–41.
- Hayes, Andrew F. (2013), *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, New York: Guilford.
- Hays, Kate F. (2012), "The Psychology of Performance in Sport and Other Domains," in *The Oxford Handbook of Sport and Performance Psychology*, ed. Shane Murphy, New York: Oxford University Press, 24–45.
- Heyman, James E., Yesim Orhun, and Dan Ariely (2004), "Auction Fever: The Effect of Opponents and Quasi-Endowment on Product Valuations," *Journal of Interactive Marketing*, 18 (4), 7–21.
- Jap, Sandy D. and Ernan Haruvy (2008), "Interorganizational Relationships and Bidding Behavior in Industrial Online Reverse Auctions," *Journal of Marketing Research*, 45 (5), 550–61.
- Jaworski, Bernard J. and Ajay K. Kohli (1993), "Market Orientation: Antecedents and Consequences," *Journal of Marketing*, 57 (3), 53–70.
- Johnson, Eric, Gerald Häubl, and Anat Keinan (2007), "Aspects of Endowment: A Query Theory of Value Construction," *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 33 (3), 461–74.
- Kagel, John H. (1995), "Auctions: A Survey of Experimental Research," in *The Handbook of Experimental Economics*, ed. John H. Kagel and Alvin E. Roth, Princeton, NJ: Princeton University Press.
- Kagel, John H., Ronald M. Harstad, and Dan Levin (1987), "Information Impact and Allocation Rules in Auctions with Affiliated Private Values: A Laboratory Study," *Econometrica*, 55 (6), 1275–304.
- Kagel, John H. and Dan Levin (1986), "The Winner's Curse and Public Information in Common Value Auctions," *American Economic Review*, 76 (5), 894–920.
- Kamins, Michael A., Xavier Drèze, and Valerie S. Folkes (2004), "Effects of Seller-Supplied Prices on Buyers' Product



- Evaluations: Reference Prices in an Internet Auction Context," *Journal of Consumer Research*, 30 (4), 622–8.
- Katok, Elena and Anthony M. Kwasnica (2008), "Time Is Money: The Effect of Clock Speed on Seller's Revenue in Dutch Auctions," *Experimental Economics*, 11 (4), 344–57.
- Kilduff, Gavin J. (2014), "Driven to Win: Rivalry, Motivation, and Performance," *Social Psychological and Personality Science*, 5 (8), 944–52.
- Krishna, Vijay (2009), *Auction Theory*, Burlington, MA: Academic Press.
- Ku, Gillian, Deepak Malhotra, and J. Keith Murnighan (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.
- Larsen, Britta A., Arseny A. Ryazanov, Jason T. Gravano, and Nicholas J. S. Christenfeld (2015), "Competition Breeds Desire," *Basic and Applied Social Psychology*, 37 (1), 81–6.
- Litt, Ab, Uzma Khan, and Baba Shiv (2010), "Lusting While Loathing: Parallel Counterdriving of Wanting and Liking," *Psychological Science*, 21 (1), 118–25.
- Loewenstein, George F., Leigh Thompson, and Max H. Bazerman (1989), "Social Utility and Decision Making in Interpersonal Contexts," *Journal of Personality and Social Psychology*, 57 (3), 426–41.
- Lucking-Reiley, David (2000), "Auctions on the Internet: What's Being Auctioned, and How?" *Journal of Industrial Economics*, 48 (3), 227–52.
- Malhotra, Deepak (2010), "The Desire to Win: The Effects of Competitive Arousal on Motivation and Behavior," *Organizational Behavior and Human Decision Processes*, 111 (2), 139–46.
- Mano, Haim and Richard L. Oliver (1993), "Assessing the Dimensionality and Structure of the Consumption Experience: Evaluation, Feeling, and Satisfaction," *Journal of Consumer Research*, 20 (3), 451–66.
- Mazur, Allan, Alan Booth, and James M. Dabbs Jr. (1992), "Testosterone and Chess Competition," *Social Psychology Quarterly*, 55 (1), 70–7.
- McAfee, R. Preston and John McMillan (1987), "Auctions and Bidding," *Journal of Economic Literature*, 25 (2), 699–738.
- Milgrom, Paul and Robert J. Weber (1982), "A Theory of Auctions and Competitive Bidding," *Econometrica*, 50 (5), 1089–122.
- Norton, David A., Cait Poyner Lamberton, and Rebecca Walker Naylor (2013), "The Devil You (Don't) Know: Interpersonal Ambiguity and Inference Making in Competitive Contexts," *Journal of Consumer Research*, 40 (2), 239–54.
- Nunes, Joseph C. and Peter Boatwright (2004), "Incidental Prices and Their Effect on Willingness to Pay," *Journal of Marketing Research*, 41 (4), 457–66.
- Park, Young-Hoon and Eric T. Bradlow (2005), "An Integrated Model for Bidding Behavior in Internet Auctions: Whether, Who, When, and How Much," *Journal of Marketing Research*, 42 (4), 470–82.
- Popkowski Leszczyc, Peter T. L., Chun Qiu, and Yongfu He (2009), "Empirical Testing of the Reference Price Effect of Buy-Now Prices in Internet Auctions," *Journal of Retailing*, 85 (2), 211–21.
- Popkowski Leszczyc, Peter T. L. and Michael H. Rothkopf (2010), "Charitable Motives and Bidding in Charity Auctions," *Management Science*, 56 (3), 399–413.
- Porter, Michael E. (2008), "The Five Competitive Forces That Shape Strategy," *Harvard Business Review*, 86 (1), 78–93.
- Preacher, Kristopher J. and Andrew F. Hayes (2008), "Asymptotic and Resampling Strategies for Assessing and Comparing Indirect Effects in Multiple Mediator Models," *Behavior Research Methods*, 40 (3), 879–91.
- Putrevu, Sanjay and Brian T. Ratchford (1997), "A Model of Search Behavior with an Application to Grocery Shopping," *Journal of Retailing*, 73 (4), 463–85.
- Roth, Alvin E. and Axel Ockenfels (2002), "Last Minute Bidding and the Rules for Ending Second-Price Auctions: Evidence from eBay and Amazon Auctions on the Internet," *American Economic Review*, 92 (4), 1093–1103.
- Smith, Charles W. (1989), *Auctions: The Social Construction of Value*, New York: Free Press.
- Spann, Martin, Gerald Häubl, Martin Bernhardt, and Bernd Skiera (2012), "Bid-Elicitation Interfaces and Bidding Behavior in Interactive Pricing," *Journal of Retailing*, 88 (1), 131–44.
- Srivastava, Joydeep and Shweta Oza (2006), "Effect of Response Time on Perceptions of Bargaining Outcomes," *Journal of Consumer Research*, 33 (2), 266–72.
- Stanne, Mary Beth, David W. Johnson, and Roger T. Johnson (1999), "Does Competition Enhance or Inhibit Motor Performance: A Meta-Analysis," *Psychological Bulletin*, 125 (1), 133–54.
- Van den Bos, Wouter, Jian Li, Tatiana Lau, Eric Maskin, Jonathan D. Cohen, P. Read Montague, and Samuel M. McClure (2008), "The Value of Victory: Social Origins of the Winner's Curse in Common Value Auctions," *Judgment and Decision Making*, 3 (7), 483–92.
- Zeithammer, Robert and Christopher Adams (2010), "The Sealed-Bid Abstraction in Online Auctions," *Marketing Science*, 29 (6), 964–87.
- Zhao, Xinshu, John G. Lynch Jr., and Qimei Chen (2010), "Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis," *Journal of Consumer Research*, 37 (2), 197–206.