

Action Simulation in Acquisition Cost Estimates

by

Aner Tal

Department of Business Administration
Duke University

Date: _____

Approved:

Dan Ariely, Co-Chair

Joel Huber, Co-Chair

Kurt Carlson

Dennis Proffitt

Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in the Department of
Business Administration in the Graduate School
of Duke University

ABSTRACT

Action Simulation in Acquisition Cost Estimates

By

Aner Tal

Department of Business Administration
Duke University

Date: _____

Approved:

Dan Ariely, Co-Chair

Joel Huber, Co-Chair

Kurt Carlson

Dennis Proffitt

An abstract of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Business Administration in the Graduate School of Duke University

Copyright
by Aner Tal
2009

Abstract

Consumers often lack objective information about product acquisition costs. In such cases, consumers must rely on estimates of acquisition costs in making their choices. The current work examines the influence of mental simulations of product acquisition on estimates of acquisition costs. We suggest that simulations of product acquisition lead estimates to reflect the influence of consumers' current physical states on the experience of a particular cost. Specifically, carrying a heavy burden leads consumers to estimate higher distances to targets when they engage in simulation of walking to targets, but not when they do not engage in such simulation.

Simulation can be either deliberate or spontaneous. Deliberate simulation is engaged when consumers intentionally simulate an action. Spontaneous simulation requires particular conditions for its occurrence, but does not require conscious intent. The specific conditions for the occurrence of spontaneous simulation are the availability of situational inputs and that action be possible in the given situation. We support these ideas in a series of studies.

Study 1 demonstrates preference shifts that occur as a consequence of participants carrying heavy burdens. Participants in this study shifted their preference from an option located a visible but undefined distance away towards one that was available at their current location. Study 2 supports the theory that this shift occurs as a consequence of alterations in estimates of acquisition costs by showing that burdened participants estimate distances as greater than do unburdened participants.

Study 3 provides evidence for the role of mental simulation in producing such changes in estimated acquisition costs by showing that the distance expansion first demonstrated in study 2 occurs when targets are visible, but not when targets are not visible. This result is consistent with the central contention of this dissertation that visibility is critical for spontaneous simulation. Together, the studies support the role of spontaneous simulation in burden leading to distance expansion.

Study 4 provides further support for the role of simulation in producing the effects of physical state on estimated acquisition costs by showing deliberate simulation results in similar distance to that of spontaneous simulation.

Study 5 further demonstrates the dual roles of spontaneous and deliberate simulation on distance expansion. It shows that expansion does not occur when targets are not reachable because they are up in the air. However, deliberate simulation of actions restores distance expansion in those circumstances, supporting the role of simulation in leading to consideration of physical state in estimated acquisition costs.

The final study ties together these results by demonstrating the effects of both spontaneous and deliberate simulation in a single setting. Varying both the availability of conditions supporting spontaneous simulation and instructions for deliberate simulation the study allows an examination of the comparative effects of the two types of simulation and of their potential interaction. The study finds that deliberate simulation may produce effects that are larger than those of spontaneous simulation, at least in conditions where visual inputs are lacking, but spontaneous simulation does not seem to enhance the effects of deliberate simulation.

Contents

Abstract	iv
Contents	vi
List of Tables	x
List of Figures	xi
1. Introduction.....	1
1.1. Introduction: Simulation in Consumer Judgment.....	2
1.2. The Occurrence of Simulation in Consumer Judgment.....	3
1.3. Effects of Simulation on Acquisition Cost Estimates: The Case of Distance Estimation	5
1.4. Importance of the Current Research	7
1.5. Organization of the Dissertation	9
2. Simulation in Consumer Acquisition Cost Estimates: How Physical Burden Affects Distance Estimation	11
2.1. Mental Simulation of Product Acquisition and its Effect on Acquisition Cost Estimates.....	14
2.2. Simulation in Distance Expansion.....	16
2.3. Simulations are Situated and Embodied	17
2.4. Hypotheses.....	19
2.5. Conditions for Spontaneous Simulation	21

2.6. Research Overview	23
3. Distance estimates and preference shifts in situations conducive to spontaneous simulation.....	25
3.1. Study 1: Effects of encumbrance on product preferences	25
3.1.1. Methods.....	26
3.1.1.1. Design	26
3.1.1.2. Materials	26
3.1.1.3. Procedure	26
3.1.2. Results.....	28
3.1.3. Discussion	28
3.2. Study 2: The effect of encumbrance on distance perception	30
3.2.1 Methods.....	30
3.2.1.1. Materials	31
3.2.1.2. Procedure	31
3.2.2. Results.....	32
3.2.3. Discussion	33
4. Dependency of distance expansion effects on simulation: visual inputs as a precondition for spontaneous simulation	35
4.1. Study 3: Does non-visibility reverse the effect of encumbrance on distance estimation?	35
4.1.1. Methods.....	35

4.1.2. Results.....	36
4.1.3. Discussion.....	38
4.2. Study 4: Expansion hinges on deliberate simulation for non-visible targets.....	39
4.2.1. Methods.....	39
4.2.1.1. Design.....	39
4.2.1.2. Participants.....	40
4.2.1.3. Procedure.....	40
4.2.2. Results.....	41
4.2.3. Discussion.....	43
5. Dependency of distance expansion effects of simulation: the possibility of action	45
5.1. Study 5: Simulation depends on the possibility for action: Reachability of targets	45
5.1.1. Methods.....	46
5.1.1.1. Design.....	46
5.1.1.2. Procedure.....	46
5.1.2. Results.....	46
5.1.3. Discussion.....	47
6. Comparing the effects of spontaneous and deliberate simulation	49
6.1. Study 6: Expansion Effects Depend on Simulation.....	49
6.1.1. Methods.....	52

6.1.1.1. Design	52
6.1.1.2. Procedure	52
6.1.2. Results	54
6.1.3. Discussion	57
7. Simulations effects on judgment: Implications and extensions	59
7.1. Extensions and Contributions	62
7.2. Implications	65
Appendix: Analyses results	69
References	72
Biography	77

List of Tables

Table 1: Predictions across conditions.....	52
Table 2: Tests of fixed effects (type 3) for study 6.....	55

List of Figures

Figure 1: Distance expands for participants wearing a heavy backpack	33
Figure 2a: Expansion occurs only when participants can see paths: distance	37
Figure 2b: Expansion occurs only when participants can see paths: distortion.....	38
Figure 3a: No expansion for non-visible targets without deliberate simulation: distance	42
Figure 3b: No expansion for non-visible targets without deliberate simulation: distortion	42
Figure 4: Unreachable objects expand given deliberate simulation	47
Figure 5: Expansion occurs only with visible targets or deliberate simulation	56
Figure 6: Map of study area	56

1. Introduction

The current work discusses the effects of consumers' simulations of product acquisition on estimated acquisition costs, focusing on the estimation of distance to marketing targets. The main thesis is that either spontaneously occurring or deliberate simulations of product acquisition lead consumer estimates to reflect the influence of their current physical state on the anticipated experience of product acquisition.

In addition, the studies explore the conditions under which the effects of simulation would occur. Specifically, the studies demonstrate that the effects of simulation occur either when consumers engage in deliberate simulation of product acquisition or when conditions support spontaneous simulation. The specific conditions required for the occurrence of spontaneous simulation are the availability of visual inputs and the availability of immediate action the consumer can engage in within the current environment.

The current chapter provides a brief overview of the work. Chapter 2 presents the theoretical development and hypotheses in greater detail. Chapters 3-6 present our empirical findings supporting the theory. Chapter 7 reviews the findings and discusses practical implications of the research as well as extensions of its application to different judgment domains.

1.1. Introduction: Simulation in Consumer Judgment

Consumers' experience of products depends on their physical state. Colloquially, people are aware that food is tastier when you're hungry, water tastes better than the finest of champagnes after a sweaty workout, and a pillow feels softer after working through the night to make a deadline. Research corroborates and extends this intuition, demonstrating that hunger affects food desirability (Mobini et al. 2007; Zverev 2004), heat sensations changes given different body temperature (Cabanac 1979), and salt deprivation alters the taste of salty food (Blais et al. 1986).

Such altered experiences of product properties due to physical state are revealed through actual, sensory product experience. The work presented in this dissertation contends that mental simulations of actions relating to products can, similarly to actual experience, alter the way a product is judged, reflecting the would be effects of current physical state on product experience. In other words, imagining the process of product interaction or consumption can lead judgment to reflect how product experience would be altered due to current physical state. Accordingly, food would seem tastier following simulation of eating when hungry, and distances would seem longer following simulation of walking when burdened.

1.2. The Occurrence of Simulation in Consumer Judgment

Extensive work in cognitive psychology (Barsalou 2003; Jeannerod 2001) has demonstrated that action simulation occurs spontaneously in a variety of circumstances. In other words, the human cognitive system simulates various actions a person can commit at a given time as part of its normal functioning. The effects of physical state on (anticipated) product experience should become apparent through simulations of product interaction, as these provide close approximations of reality and consider current circumstance, including the consumers' physical state and its effects on her relation to the current environment. Accordingly, and given the prevalence of spontaneous simulation, we can anticipate that the effects of consumers' physical state would be reflected in judgment even in the absence of actual product experience.

Simulation can occur as a deliberate, intentional process as well as a spontaneously triggered process. Extensive work in marketing and outside it has looked at how deliberate simulations affect people's conduct and a variety of judgments (Taylor et al. 1998; Escales 2003; Escales & Luce 2004; Philips 1996). However, the role of such simulation in producing projective effects of current physical state in judgment has, thus far, not been explored. As implied above, we expect simulation to lead judgment to reflect the effects of current physical state on product experience. In other words, given simulation of product acquisition, judgment of an acquisition cost should reflect the subjective costs imposed by the consumers' current physical state.

Spontaneous simulations are prevalent in a broad array of basic cognitions (Barsalou 2003; Glenberg & Kaschak 2002; Niedenthal et al. 2005). However, certain conditions are required for spontaneous simulation to occur. These conditions should dictate when spontaneous simulation occurs, and so when it would have its effects on product judgment. Accordingly, to understand when the effects of physical condition on judgment would occur, it is important to understand the conditions needed for the occurrence of spontaneous simulation.

Research exploring the occurrence of spontaneous simulation has, naturally, been conducted under conditions that support the occurrence of simulation. Such research can thus teach us what conditions are required for the occurrence of spontaneous simulation.

One condition that occurred through all research on spontaneous simulation is that objects triggering simulation have been available for direct perception, either by actual presence or by vivid visual representation. A second condition is that the simulation-triggering object has allowed immediate action given participants' current position in the environment. Accordingly, we can hypothesize that for the effects of spontaneous simulation to occur direct inputs are required and action needs to be possible.

1.3. Effects of Simulation on Acquisition Cost Estimates: The Case of Distance Estimation

The studies reported in this dissertation focus on the effects of simulation of product acquisition on estimated acquisition costs. Acquisition costs can play an important role in consumer decisions. They are often not given in precise values, and so require estimation, which may be influenced by the process of action simulation. The consumer's physical state can influence the subjective costs involved in acquiring a product, and, through simulation, this alteration in subjective costs can translate to estimation of the "objective" level of a cost dimension.

Various physical states have a variety of effects on perception and on subjective estimated costs. For instance, as mentioned earlier, hunger may alter the taste of food, thirst can effect the judged "refreshingness" of liquid, and tiredness should affect distance perception (Proffitt et al. 2003). The studies presented in the current work focus on the effects of physical state on distance perception, both as a convenient domain in which to explore the effects of physical state on judgment through simulation, and as a marketing relevant variable in its own right.

Distance presents a fitting domain in which to explore the effects of simulation given the existence of convenient manipulations of relevant physical states and documented effects of physical state on judgment. Specifically, the work of Dennis Proffitt and colleagues (2006; et al. 2003) demonstrates that being tired due to carrying heavy backpacks leads people to judge distances as longer

than they would without burden. This effect is considered to be an outcome of the effects of burden on the effort involved in crossing distances. In Proffitt's account, perception is oriented towards action (see Gibson 1979), such that distances are perceived in terms of the effort involved in crossing them. Carrying a heavy backpack makes crossing distances more difficult, and, consequently, makes distances expand to appear longer.

While Proffitt's account relies on direct perception to produce alterations in judgment, it may well be that the process of mental simulation mediates his documented effects (see Witt & Proffitt, in press). Simulation of the action of crossing a distance constitutes a cognitive mechanism whereby the effects of physical state on the subjective sense of distance may come to be considered. If this is indeed the case, and simulation is responsible for Proffitt's effect of burden on distance perception, we should see such effects in cases where simulation occurs, but not in cases where simulation does not occur. In other words, we should see distances expand for burdened participants when either intentional simulation or spontaneous simulation occurs, but not when neither simulation occurs.

Because of the existence of such an effect that could be explained by simulation, as well as the availability of a lab paradigm that is easily translatable to circumstances that support or do not support spontaneous simulation, the effects of burden on distance perception make for a compelling domain for an initial demonstration of the effects of simulation on judgment. In addition,

distance is in itself a judgment dimension that is of considerable importance for marketing.

1.4. Importance of the Current Research

Distance is among the central acquisition costs consumers face when making common purchase decisions (Bell et al. 1998). As such, distance has been extensively studied in consumer research in early (Brunner 1968; Cadwallader 1975; Hermann 1968; Hubbard 1978; Huff 1968; MacKay & Olshavsky 1975) and current research (Brooks et al. 2004; Kang et al. 2003; Nelson & Simmons 2009; Raghurir et al. 1996). In these and other research projects, researchers focused on distance as a central element guiding consumers' choices of shopping locations and movements within retail environments.

Distances could also guide choices in many day-to-day consumer situations that go beyond retail location choice. For instance, a consumer might be willing to travel one mile but not three miles to a coffee shop or restaurant, and so might alter her consumption decision based on estimated distance. Similarly, a consumer's preference between vacation destinations might change based on the perceived distance of the available options. On a similar vein, he might be willing to trade off more quality for proximity the farther away an alternative appears. In other words, the more distant a potential store appears to be, the more a consumer might be willing to opt for a lower-quality store that offers greater proximity.

As implied above, the influence of simulation on product judgment is important for its potential effects on preference and choice. Understanding when to expect the effects of physical state on judgment would alert marketers to the extent to which they need to consider such effects. Specifically, the effects of physical state on judgment should be considered when the situation is conducive to spontaneous simulation (e.g., the product is present and available for immediate action and consumption), and when consumers are likely to engage in simulation of their own volition (Escales 2003; Philips 1996). If the effects of simulation on judgment in the particular situation are not desirable, marketers might want to reduce the likelihood of simulation (e.g., by designing packaging in a way that does not trigger spontaneous simulation), and in situations where the effects are desirable marketers might want to encourage simulation (e.g., by presenting sample open-case items at point-of-sale or encouraging deliberate simulation through marketing communication).

From the consumer side, consumers can gain from understanding that situations conducive to simulation can lead to a biasing of their judgment in a manner that considers their current physical state and its effects on product experience. If said physical state is not relevant for the actual consumption situation (e.g., the consumer will drive rather than walk to the restaurant, and this will occur later in the day when they're rested rather than right now when they're tired), consumers might want to consider the product in a situation that does not induce spontaneous simulation and its effects on judgment (e.g., where they are

not looking at the product). This advice is similar to that of relying on a pre-written shopping list to shop when hungry. Conversely, if a consumer's current physical state is relevant for the anticipated consumption situation, they might want to imagine what consuming the product would be like in order to arrive at an ecologically valid product judgment.

On a theoretical level, understanding the manner in which simulation underlies the effects of physical state on product judgment could help clarify the situations under which a variety of known effects of physical state on judgment would occur. For instance, simulation could define the boundary conditions for Proffitt's (et al. 2003) findings. In addition, conditions for the occurrence of simulation could constitute the boundary conditions of the effects of visceral states on judgments (Loewenstein 1996). Such conditions tend to bias judgment relating to times when the current physical state may no longer apply, potentially due to simulation.

1.5. Organization of the Dissertation

The paper is divided into several chapters. Chapter 2, titled "Simulation in consumer acquisition cost estimates: how physical burden affects distance estimation," covers the theory behind our studies. Chapter 3, titled "Distance estimates and preference shifts in situations conducive to spontaneous simulation," presents the first two studies, which demonstrate the effects of

burden on preference and distance judgment in situations supporting simulation.

Chapter 4, titled “Dependency of distance expansion effects on simulation: visual inputs as a precondition for spontaneous simulation,” demonstrates the dependency of distance expansion on simulation by showing the absence of distance expansion when no visual inputs are available and their restoration given deliberate simulation in such situations. Chapter 5, “Dependency of distance expansion effects of simulation: the possibility of action” makes a similar demonstration using the possibility for action as a 2nd condition for spontaneous simulation. The final empirical chapter, chapter 6, “Comparing the effects of spontaneous and deliberate simulation,” tests both deliberate and spontaneous simulation in an integrated experimental context, allowing examination of the interaction of their effects. In chapter 7, “Simulations effects on judgment: Implications and extensions,” we review our findings and discuss their implications and potential extensions of the current research.

2. Simulation in Consumer Acquisition Cost Estimates: How Physical Burden Affects Distance Estimation

Consumer purchases tend to involve a variety of acquisition costs (Rindfleisch & Heide 1997). While price is prominent among acquisition costs, other factors are also important. For example, a consumer may have to travel to the store, look for products in the store, spend time deciding between options, stand in line to check out, complete the checkout, transport the products back home, and assemble them. These stages of acquisition can carry costs that might influence the consumer decision making process. For instance, consumers often take into account distance to a store when deciding which store to visit (Bell, Ho and Tang 1998; Brooks et al. 2004; Caldwell 1975; Raghuram & Krishna 1996). Similarly, estimated wait time in line can influence purchase decisions (Kostecki 1996; Leclerc, Schmitt and Dube 1995; Schwanz 1975).¹

For acquisition costs to be used as decision inputs, consumers must have an estimate of these costs. In some instances, it is easy to gather objective information about acquisition costs (e.g., when a GPS indicates the distance to a store). However, in many situations such information is not available, so that consumers must estimate costs (e.g., Hornik 1984; Raghuram 1996). For example,

¹ Given their importance, acquisition costs have garnered considerable attention from both economists and marketing researchers. For instance, much research has focused on distances to stores, on which we focus in the current work (Herrmann & Beik 1968; Huff 1964; MacKay 1975; Nelson and Simmons 2009; Raghuram and Krishna 1996). In this and other work, considerable attention has been given not only to the effects of acquisition costs on behavior but also to the process of learning about or estimating these costs.

a consumer walking around an unfamiliar city might not know the exact distance of a Chinese restaurant they passed on their drive into the city, and so might need to estimate the distance based on their own subjective sense of the environment.

Two distinct elements can influence consumers' estimates of acquisition costs. First, the environment can impact acquisition costs. The time it takes to travel to the store is influenced by distance and impediments in the route, time waiting in the checkout line depends on the number of people in line and the speed of the checkout clerk, wait time to receive one's order in a restaurant depends on the number of people working and the number of orders in the queue.

Second, consumers' current states can influence acquisition costs. Their energy level can dictate how long it will take to walk a certain distance, knowledge of the store might influence how long it takes them to locate a product, and familiarity with the options might influence how long it takes them to choose a particular brand.

Consumers' estimates of different acquisition costs are important for their role in consumers' planning and choice behavior (see Morwitz 1997 for this argument in relation to time durations; Nelson & Simmons 2009 for distance estimates). Understanding systematic biases in estimates of acquisition costs is also of considerable importance. This is because biases can lead to changes in consumers' preferences that might in turn guide choices and potentially lead to suboptimal decisions (Raghubir & Krishna 1996; Krishna, Zhou and Shang 2008; Nelson & Simmons 2009). For example, a consumer's decision might change if

they perceive costs to be higher or lower: they might be willing to walk to a Chinese restaurant if they estimate it will take less than 10 minutes to do so, but unwilling to walk if they estimate it will take longer than this.. In such a case a biased estimate of the time it takes to get to a destination might reverse a shopping decision.

Estimates of acquisition costs may also feature in consumers' plans. If consumers estimate higher costs involved in acquiring a product or service (e.g., the time it would take to obtain it), they may make fewer purchases than they would had they perceived lower transaction costs. Such plans are important because once formed, consumers are likely to follow them to completion (Gollwitzer 1999; Morwitz 1997; Pham & Taylor 1999). Moreover, since some purchases are made in advance (e.g., trip reservations, retirement funds), plans may at times result in immediate purchase behavior.

Given the prevalence of cases in which consumers need to estimate acquisition costs, and their implications for consumer planning and decision-making, understanding the process underlying cost estimations is an important issue for marketing researchers. The current paper suggests that consumers' estimations of acquisition costs are influenced by simulations of the acquisition process, which lead consumers' physical states at the time of estimation to have an undue influence on such estimates. Specifically, we propose that in consumers' simulations of product acquisition, the consumers' current physical state alters the projected experience, which in turn alters estimates of acquisition costs. For

instance, tiredness affects the simulated experience of walking such that distances feel longer and result in longer distance estimates.

In the remainder of this paper, we'll elucidate the proposed role of simulation in shaping consumer estimates of acquisition costs. We'll then discuss the conditions under which simulation will arise spontaneously as an influence on acquisition cost estimates and propose hypotheses designed to test the circumstances and effects of simulation in the domain of distance estimation. The hypotheses will be tested in a series of four studies. Following the studies, we'll return to our theory and discuss potential extensions to additional judgment domains.

2.1. Mental Simulation of Product Acquisition and its Effect on Acquisition Cost Estimates

Simulations of product acquisition are defined as mental processes in which consumers imagine the actions and events involved in obtaining products. We refer to these as *action* simulations, as they involve simulation of concrete actions involving feasible bodily movement, rather than abstractions. Such simulations evoke specific situational details including the consumers' current bodily feelings and the particular environment in which product acquisition would occur. For example, suppose a consumer imagines walking over to a Chinese restaurant, ordering food and waiting for it to be brought to their table. If burdened with a couple of bags, they may imagine going through the first part of

this process while burdened. The heavier the bags, the longer we expect their distance estimate to be. This influence of physical burden on acquisition costs is the primary focus of this dissertation.

The prediction of higher distance estimates when burdened by a physical load is consistent with and builds on work by Proffitt (2006; Proffitt et al. 2003), who found that estimated distances (and incline steepness) were longer (and more inclined) when participants were burdened by wearing a heavy backpack. Participants in Proffitt's (et al. 2003) studies estimated distances to markers placed in an open field. Each participant estimated distances to 12 targets, with targets being treated as repeated observations. Half the participants in his studies wore heavy backpacks and half did not wear backpacks. Those participants who carried heavy backpacks estimated distances that were on average higher than those estimated by no-backpack participants.

Notably, an effect of burden on distance estimates is more revealing than a similar effect on estimates of time to walk to a target. That is because time-to-walk is in itself a subjective, rather than an objectively given, variable. Walking time to a target might be influenced by burden, whereas distances do not change. Accordingly, a change in estimated time to walk could not be properly considered to be a distortion, whereas a change in estimated distance due to burden would constitute a bias.

The first objective of this dissertation is examination of this extension of Proffitt's results in the context of a complex consumer setting. The second

objective is to develop a better understanding for contexts in which the distance expansion effect occurs. To this end, we examine the connection between mental simulation and distance estimates. More generally, we examine the place of simulation in obtaining the effects of physical state on estimates of acquisition costs.

2.2. Simulation in Distance Expansion

Proffitt's (et al. 2003) research revealed that carrying a burden leads participants to estimate distances as longer than they would when unburdened. The question remains as to the process whereby weight comes to influence distance estimates. Proffitt's (2006) account is that people consider the environment in terms of the actions it allows them to take. In other words, distance is not perceived in objective geometric terms but rather in terms of the actions it allows people. Since crossing distances would be more effortful when one carries a backpack, it would take longer to cross the distance while carrying a backpack than it would without a backpack, and therefore, the distance will seem longer when carrying a backpack. According to Proffitt, then, perception is functional, reflecting properties of the environment as they concern and influence human action. Thus, distances are 'read' in terms of the effort it would take to cross them, rather than in terms of their objective geometric properties.

Though silent on the role of simulation, the idea that distance estimates are functional in nature suggests that individuals are considering relevant actions in their judgment. It is possible that this consideration of the functional properties of objects in the environment occurs through simulation, which is, accordingly, the process through which weight burden influences distance estimates.

2.3. Simulations are Situated and Embodied

Research about mental simulations verifies their situated nature (Barsalou 2003; Glenberg and Kaschak 2002; Jeannerod 2001). Simulations show sensitivity to both people's physicality and their environment (Anzola et al. 1977; Borghi et al. 2004; Fischer et al. 2007; Grezes et al 2003; Tucker & Ellis 1998). That is, simulated experiences are different when consumers are in different physical states (e.g., tired or alert). Being tired due to physical load, for instance, affects what walking feels like in simulation.

In addition, simulations are sensitive to actions the environment allows the person to perform (e.g., whether an item is positioned in a manner allowing use - Handy et al. 2003; Johnson 2000; Symes et al. 2007). If no action is possible, brain areas associated with action and action simulation are not activated. It appears, then, that action simulation occurs only when action is possible, and in this manner spontaneously considers environmental conditions.

Translated to the consumer domain, simulations of a consumer's physical state may be an integral part of a consumer's acquisition costs, and so should be reflected in estimates of acquisition costs. Consumers currently carrying a load of heavy shopping bags would imagine walking to the next store while carrying the bags. Since heavy shopping bags would make walking over to the store more difficult, acquisition cost estimates for these consumers should be higher than those of consumers unburdened by heavy bags.

Accordingly, we posit that action simulation may be the process through which distance estimates are influenced by people's burdened physical state. If so, then distances should only appear longer to burdened participants when those participants are capable of engaging in such simulation. Distance expansion effects should then be restricted to circumstances that either support spontaneous simulation or encourage consumers to deliberately engage in simulation of product acquisition.

In the next section, we will elaborate on the reasons for our hypothesis on the influence of simulation on judgment as applied to the case of distance, and discuss the specific conditions under which spontaneous and deliberate simulation would arise.

2.4. Hypotheses

As stated above, we posit that consumers' physical state is integrated into their action simulations. Burdens consumers carry (e.g., shopping bags) should thus be felt in simulated actions because they are part of consumers' current physical state. Walking with a burden is more effortful than walking unburdened. Similarly, walking with a burden would feel more effortful than walking without a burden in simulated experience. In simulations of the action of walking with a heavy burden, then, distances would feel longer than in action simulations of walking without burden. This subjective extension of distance would in turn translate to longer distance estimates. Thus, in circumstances where consumers engage in simulation, we can expect a main effect of burden.

H1: Where consumers simulate walking to targets, those carrying a heavy burden estimate distances as longer than consumers not carrying a heavy burden.

When there is no action simulation, the effect of burden on walking would not be apparent. Because of this, when they do not simulate, burdened consumers would not estimate distances as longer. Thus, we expect an interaction between burden and simulation such that, all else being equal, estimated distances would be higher for burdened (relative to unburdened) participants who engage in simulation of acquisition, but no such difference should obtain when participants do not engage in simulation.

H2: There will be an interaction of burden and simulation such that distances appear longer to burdened consumers only in conditions that support spontaneous action simulation or where consumers engage in deliberate action simulation.

Simulation can occur spontaneously or deliberately. Spontaneous simulations are simulations that arise spontaneously, without intention and conscious guidance on the part of the consumer. Deliberate simulations, on the other hand, are intentionally initiated and intentionally pursued imaginings.

Without a reason to engage in deliberate simulation, it is unlikely that consumers would deliberately simulate walking to targets. In the absence of deliberate simulation, distance expansion would depend on the occurrence of spontaneous simulation. Accordingly, distances should only appear farther away to burdened participants (relative to unburdened participants) when conditions foster spontaneous simulation.

When simulation does not occur spontaneously, consumers can still deliberately engage in simulation. Deliberate simulation reflects the effects of physical state on action in the same manner as spontaneous simulation does, and so should lead to equivalent effects. In other words, if they engage in deliberate simulation of crossing distances, burdened consumers should estimate distances as longer than do unburdened consumers even in the absence of conditions that support spontaneous simulation, or prompt deliberate simulation.

In cases where circumstances do not support spontaneous simulation, then, *deliberate simulation* can produce higher distance estimates for burdened participants. Without deliberate simulation, though, such expansion of distance estimates would not occur, due to the absence of spontaneous simulation. Accordingly, we would expect an interaction of burden and deliberate simulation, such that in circumstances that do not support spontaneous simulation, distances would only appear longer to burdened participants who deliberately simulate, but not to burdened participants who do not deliberately simulate.

H3: Where spontaneous simulation is unlikely to occur, there will be an interaction of deliberate simulation and burden such that only burdened consumers who are prompted to engage in active simulation will estimate targets as being farther away than do unburdened consumers.

To summarize, there should be an interaction of prompted simulation and burden such that burden only leads to higher distance estimations when consumers are urged to simulate or spontaneously engage in simulation. Before moving on to our studies, we elaborate on the specific conditions (in H3) that lead to spontaneous simulation.

2.5. Conditions for Spontaneous Simulation

The hypotheses above are incomplete in the sense that the conditions for spontaneous simulation have not been defined. Extant research in cognitive

psychology can help predict the conditions under which action simulation should spontaneously occur (and so, if our account is correct, distance expansion should occur).

First, it is harder to simulate that which you cannot see. The sensitivity of simulations to situational inputs and the manner in which they incorporate such inputs suggest that the presence of situational inputs should be crucial for their spontaneous occurrence.

In prior research in cognitive psychology, the availability of visual inputs regarding action has, indeed, been a crucial element of the experimental environment (Fischer et al. 2007; Handy et al. 2003). From this we can predict that without sufficient inputs about the action environment (e.g., when participants cannot see the paths through which they would walk to targets), simulation is less likely to be spontaneously evoked.

Second, another crucial aspect of experiments showing neural evidence for action simulation is that they involved situations and objects that made action possible (e.g., objects a person could grasp or use). If an object is not usable, simulation is less likely to occur. Similarly, if one cannot walk to a target, simulation of the act of walking is less likely. In other words, the possibility of action is important for spontaneously triggering simulation. Accordingly, we can also predict that simulation is more likely to arise when there is an action consumers may take in the situation. For instance, if a chasm separates a person from the target, reaching the target is not possible, and spontaneous simulation

may not arise. Similarly, if a target is up in the air, a person would not be able to reach it without additional tools, and so spontaneous simulation is less likely to occur.

However, as stated above, consumers can deliberately engage in simulation even in situations that do not support its spontaneous occurrence. Thus, when visual inputs are not available or action is not possible, burdened participants may still estimate distances as longer than unburdened participants, but only if they are encouraged to engage in deliberate action simulation.

H4a: Consumers are less likely to spontaneously engage in simulation where there are no visual inputs or the simulated action is not feasible. In those cases, and barring deliberate simulation, participants carrying heavy backpacks will not estimate distances as longer than do participants unencumbered by heavy backpacks.

2.6. Research Overview

The studies below are designed to test whether simulation does indeed lead burdened participants to estimate distances as longer than do unburdened participants. Burden is operationalized by having some participants carry backpacks with little weight (five pounds), while others carry backpacks containing weights amounting to 15% of their body weight. Distance is assessed through open-ended estimates provided by participants, and close-ended estimates

in one case (study 6). In each study participants provide estimates for a number of different targets.

The first study demonstrates the importance of distance expansion for consumer choice by demonstrating preference shifts given burden (study 1). These preference shifts could emanate from either differential weighting of similar estimated distances, or from expansion of estimated distances. If simulation leads to this distance expansion effect, we should see burdened participants estimating distances as longer than do unburdened participants in circumstances that support distance expansion (study 2, 6, H1). However, in circumstances that do not support simulation, consumers will not spontaneously simulate walking over to targets. Thus, there should be an interaction between burden and circumstance such that burden only produces higher distance estimates in circumstances that do support spontaneous simulation (study 3, 6, H2). If that is the case, we should not see a difference between the distance estimates of burdened and unburdened participants when visual inputs are lacking (study 4, 6, H4) or action is not possible (study 5, H4). In these circumstances, deliberate simulation by participants, prompted by instructions to engage in simulation of walking, should restore distance expansion, leading burdened participants to once again estimate longer distances than their unburdened counterparts (studies 4-6, H3). Our final study compares the effects of spontaneous and deliberate simulation by examining them both in the context of a single experimental setting (study 6).

3. Distance estimates and preference shifts in situations conducive to spontaneous simulation

3.1. Study 1: Effects of encumbrance on product preferences

If burden does indeed lead to alterations in consumers' estimates of acquisition costs, it should bring about an alteration in consumers' preferences that reflects the differences in estimated costs. Specifically, consumers should shift their preferences away from a product as they estimate higher acquisition costs for it compared to its alternatives. In regards to distance, preference should shift away from an option the greater its estimated distance compared to an alternative. Accordingly, if distances are perceived to be greater for burdened participants under simulation-conducive conditions, preference should shift away from an option at an unknown distance (because it will be perceived as farther away) and towards an alternative that is available without walking (i.e., at the consumer's current position).

The current study tests this notion by examining whether consumers' preferences would shift away from a superior option towards an inferior one when wearing backpacks, given the need to walk an unspecified (but visible) distance to the superior option. If targets appear farther away to burdened consumers, they should see the superior option as being farther away. Given its higher estimated acquisition costs, they should display a lower preference for it.

3.1.1. Methods

3.1.1.1. Design

The study was a 2 cell between-subjects design with repeated measures. Participants were randomly assigned to either heavy or light backpack conditions. Each participant indicated preferences between 5 sets of two options.

3.1.1.2. Materials

Materials consisted of six standard backpacks and two different types of weights. Weights included exercise balls (6, 8, or 10 pounds) and ankle weights (5 pounds, separable to five one pound pouches). Both types of weights were pre-tested to ensure they fit and could be carried comfortably in the bags used. The backpacks were padded and included a waist-strap participants could use to help carry the load.

3.1.1.2. Procedure

Participants ($N = 53$) were divided to heavy and light backpack conditions. Each participant completed the study in a group of participants assigned to the same condition. Light backpack participants wore backpacks containing 5 pound weights. Heavy backpack participants wore backpacks containing weight calibrated to 15% of their body-weight.

Before answering the questionnaires, participants walked from the business school's behavioral lab to a location just outside the school. Walking

with the backpacks ensured participants could get a feel for the burden they were carrying. In addition, participants were asked to remain standing throughout the study so that they could feel the continuous burden of the backpacks. Similar measures were taken in all studies reported in this work.

The study took place just outside the business school. Here, participants were asked about their preference in a hypothetical lunch choice scenario. In each of five instances, participants indicated their preference between a sandwich and a hot lunch. In each instance, the location of one alternative, the hot lunch, was varied, while the location of the sandwich was always specified as being at the study's location, where participants were standing. In all, participants made five sequential choices between the nearer sandwich and the farther hot meal. Importantly, each of the "hot lunch" locations was visible and could be reached by walking from the participants' position. This supplied the necessary conditions for spontaneous simulation to occur. We return to this issue later.

Participants reported each preference on a 9-point scale anchored by 1 (= strongly prefer sandwich at current location) and 9 (= strongly prefer hot lunch at location X). At the end of the study, participants also reported on their general preference between sandwiches and a hot meal as a lunch choice on a 9 point scale anchored by strongly prefer sandwich (1) to strongly prefer hot lunch (9). This measure revealed a slight preference for hot lunches ($M = 6.89$): a t-test for the preference towards hot lunch indicated that it was significantly greater than 5, the mid-point between the two options ($t(52) = 6.3X, p < .0001$). Thus, the

preference between sandwich at the study's location versus a hot lunch at a different place would (on average) constitute a trade-off between perceived distance and general preferences.¹

3.1.2. Results

The data was examined using a mixed model analysis with destination as a repeated measure, and burden as a between participants variable. The covariance structure was specified as unstructured. This structure provided the best fit according to information criteria for both this and the following study.

As anticipated, participants preferred the inferior, but closer sandwich to the superior but farther hot meal to a greater extent if carrying heavy backpacks. Preference shifted from 5.78 (out of 9) in favor of the hot meal to 5.16, such that burden exerted a non-significant, but directional effect on preference: $F(1, 51) = 1.27, p = .26$.

3.1.3. Discussion

Participants wearing a heavy backpack expressed a non-significant stronger preference towards a sandwich at their current location over a hot lunch at a location within walking distance. Ostensibly, this occurred because burdened

¹ There was no significant relation between burden and general preference for hot lunch ($p > .1$). In other words, burden did not affect people's preference for hot lunches over sandwiches in general, but rather just when differing distances between the two options were a consideration.

participants saw the hot lunch alternative as farther away than did their unburdened counterparts. Participants who were burdened with a heavy backpack shifted their preference from the slightly superior hot lunch that required walking to the sandwich that did not require walking. In other words, higher costs of acquiring the hot lunch led to a shift away from the farther option to the nearer option when participants were burdened.

If validated more generally, such a shift in preference could emanate from alterations in distance perception, but could also result from other shifts occurring due to burden. Specifically, participants could have seen the targets as being of similar distance in both conditions, but preferred the closer target in the heavy backpack condition to avoid the more effortful walk. In other words, transaction costs could have been higher due to the subjective effort involved in crossing the distance rather than to an actual alteration in how far away targets were perceived to be.

The next study was designed to support the notion that distances are indeed judged as farther away by burdened participants in situations conducive to simulation. If this is indeed the case, burden would lead to enhancement in perceived acquisition costs and consequently to the preference shift displayed in the current study.

3.2. Study 2: The effect of encumbrance on distance perception

The second study tests whether the effect of burden on distance perception extend to everyday consumer acquisitions. If so, we would have some support for distance expansion being at least one of the factors underlying the preference shifts evinced in the previous study.

In a context where it is possible to walk to targets, participants encumbered by heavy backpacks are expected to spontaneously engage in simulation and consequently exhibit distance expansion (H1). That is, burdened participants will estimate distances as being farther away than unburdened participants. To test this hypothesis, participants estimated distances to products placed around a large room to simulate products on grocery store shelves. As in the previous study, backpacks varying in weight manipulated the degree of burden.

3.2.1 Methods

Fourteen participants completed the study for payment². Participants were a mixed group of undergraduate and graduate students as well as university employees. Participants completed the study in groups of up to six people assigned to either the heavy or light backpack conditions.

² Note that while this is a small sample such samples, along with repeated measures, are common in cognitive psychology in general and in Proffitt's (et al. 2003) studies in particular. Further, numerous replications of the effect reported on in the current study were found in other, unreported studies that were conducted as part of this research.

3.2.1.1. Materials

Materials were similar to those used in the last study. The study was conducted in a tiered room approximately 30 feet square across and 50 feet wide.

3.2.1.2. Procedure

Half of the participants wore heavy backpacks calibrated to about 15% of their body weight, and half wore light backpacks (5 pounds). Participants put on the backpacks at the beginning of the study and continued to wear them to its end.

Three procedures were designed to encourage participants to feel the burden imposed by the backpacks. First, participants were asked to walk down stairs from the starting position at the entrance of the classroom to a position at the opposite end of the class before beginning to estimate distances. Second, a practice phase where participants estimated distances to non-product targets provided additional time in which the weight of the backpacks could be felt. Finally, participants were asked to remain standing and avoid leaning on the wall throughout the duration of the study.

After estimating distances to the calibration targets, participants estimated distances to 21 standard edible grocery products scattered through the room (e.g., cereal box, pack of Oreos, bananas). Estimates of distance to the different products provided repeated observations from each participant, reducing noise and allowing greater stability to our analysis. The instructions were as follows: “This study is a simulation of grocery shopping. The backpack you’re carrying is

supposed to simulate carrying either your baggage or groceries when shopping. Imagine this classroom is a grocery store, and the different locations in the classroom are different aisles and shelves. We'll ask you how distant each product is from you. You can estimate the distance in any unit you're comfortable with (e.g., feet, meters, etc.) – just note which unit it is. “

Participants estimated distances using numerical units, with the unit of choice being left up to the participant. This flexibility was allowed so that participants could use familiar units with which they were comfortable working.

3.2.2. Results

A mixed analysis of variance model (SAS Proc mixed with repeated measures) with backpack weight as a between-subjects factor and product as a within-subject repeated-measures factor was used to analyze the data. As with the other studies reported here, the interaction term of product and weight was initially included in the model, but was subsequently dropped because it was not significant.

Participants who were wearing heavy backpacks estimated the average distance to the products as being greater ($M = 16.08$ feet) than participants wearing a light backpack ($M = 12.19$): $F(1, 12) = 5.84, p = .03$. The covariance structure specified for the current study was heterogeneous compound symmetry. This structure assumes that while the variance of distance estimates to each target

might be different, the covariance of each two targets is the same. This structure provided the best fit according to information criteria. In addition, there was no reason to predict differences in the covariance between different targets, such that the heterogeneous compound symmetry structure was also conceptually sensible despite its simplification compared to an unstructured specification of the covariance matrix.

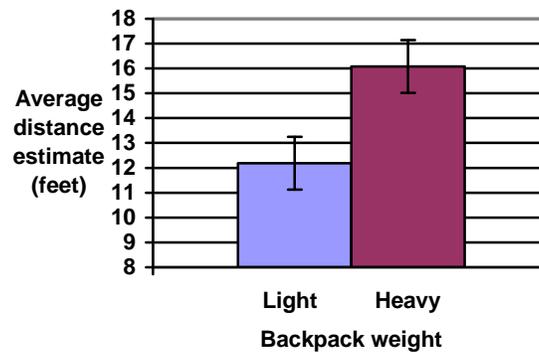


Figure 1: Distance expands for participants wearing a heavy backpack

3.2.3. Discussion

Participants carrying heavy backpacks estimated greater distances to products in a simulated grocery store scenario than participants carrying light backpacks. This provides a conceptual replication of Proffitt et al.'s (2003) studies in a consumer setting. Ostensibly, this expansion effect was obtained because participants' presence in a visually rich setting where they could see both

the targets and the paths leading to them, and their ability to walk over to the products in this setting, prompted the spontaneous occurrence of embodied action simulation.

As discussed earlier, if action simulation underlies the distance expansion effect, expansion should not occur when circumstances do not trigger simulation. Specifically, spontaneous simulation, and therefore distance expansion, should not occur when visual inputs pertaining to the action are not available. Accordingly, there should be an interaction of visibility and burden, such that distance expansion occurs only when targets are visible. The next study was designed to test this hypothesis (H2).

4. Dependency of distance expansion effects on simulation: visual inputs as a precondition for spontaneous simulation

4.1. Study 3: Does non-visibility reverse the effect of encumbrance on distance estimation?

The current study was designed to test the dependency of expansion on simulation. To this end, the study examined whether distance expansion does not happen when participants cannot see targets. If distance expansion for burdened participants depends on simulation, it should not occur when no inputs are available about the targets to which participants estimate distances, because simulation is less likely where the sensory inputs supporting it are unavailable. If expansion does indeed depend on simulation, we'd expect an interaction of target visibility and burden, such that only burdened participants who can see targets estimate distances as longer than do their non-burdened counterparts (H2).

4.1.1. Methods

Study 3 manipulated visibility directly by splitting participants ($N = 34$) into two groups: one group estimated distances to visible targets as before, and the other did so while wearing a blindfold. The setting of the study was the business school student center, a large hall with locations allowing either buying food or sitting down to eat. Participants read: "Imagine it's around lunchtime and you want to get some food here at Fuqua. Now you're trying to figure out where to go. We'll ask you to

estimate how far away places are. For each location try to *physically focus on where it is* and estimate how far it is. For each location, use the point closest to you. It's important you genuinely try to estimate the distance to each target, as these estimates will be crucial for the next phase. Please use specific numerical measures for estimation (e.g., 1.2 miles, 500 feet – rather than “very far” or 200-400m). It's very important you make each estimate separately, rather than comparing to previous estimates.” Participants estimated distances to thirteen targets.

Before putting on the blindfold, participants were instructed to carefully survey the room, since they'll be asked to estimate distances to different locations in the room once blindfolded. This allowed them to familiarize themselves with the environment and targets. To avoid random answers in cases where participants forgot the locations of some targets, participants were instructed to mark an X rather than estimating distances to targets the location of which they did not remember. Such observations, which constituted a small minority, were treated as missing observations.

4.1.2. Results

We ran a mixed model with target treated as a repeated within-subjects measure, and weight and blindfold treated as between-subjects measures¹. The covariance structure was specified as heterogeneous compound symmetry, which provided the best fit according to information criteria out of the models examined. Gender and the interaction of gender with burden were included in the model. Prior,

¹ One participant was dropped from analysis since his distance estimates were extreme outliers, lying over 3SDs from the overall mean.

unreported studies conducted in this line of research have found greater sensitivity to burden among females. Controlling for such variance may be particularly important given the small sample employed (less than 10 observations per cell).

Burden only produced significant distance effects for some participants. Namely, burdened participants estimated distances as 98 feet longer when they could see the targets: $F(1, 25) = 9.33, p = .005$. There was no such effect when participants could not see the targets ($p > .1$). Accordingly, there was a significant interaction between weight and blindfold, $F(1, 25) = 8.29, p = .008$.

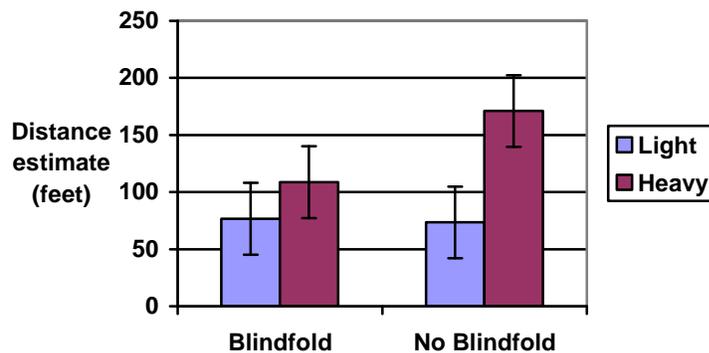


Figure 2a: Expansion occurs only when participants can see paths: distance

Because some targets were located at shorter distances than others, we wanted to take into account the objective distances to targets so as to avoid overweighting of far-away targets in means. Considering distance estimated in relation to the objective distance of each target would avoid such distortion, since such a measure of information distortion is independent of scale. This would allow us to see if a similar pattern to that obtained using distance as a DV is obtained by using distortion (estimated/objective-distance) as a DV. Accordingly, a figure showing the pattern of

results of estimated distance to each target divided by the objective distance to each target is shown below². With this measure as well, expansion only occurred for participants who could see targets. We can see that generally participants overestimated distances, but the extent of overestimation varied such that burdened participants who could see targets overestimated distances the most.

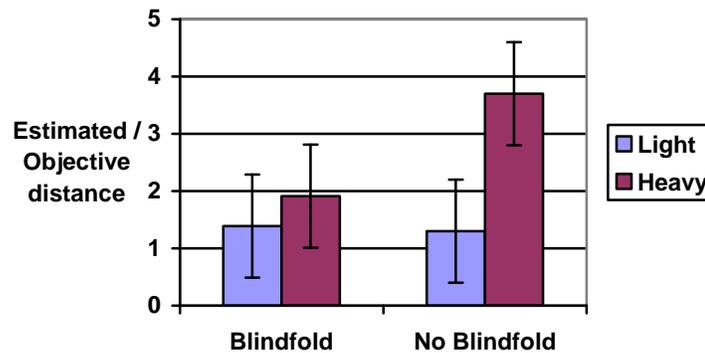


Figure 2b: Expansion occurs only when participants can see paths: distortion

4.1.3. Discussion

The results corroborate our second hypothesis. Physical burden only makes distances appear farther away if participants are given full visual inputs. The same pattern of results obtained using both distance and distortion in distance estimation as dependent measures. The restriction of distance expansion to visible conditions likely occurs because situational inputs are crucial for the occurrence of simulation, and simulation is necessary for the reflection of physical state in judgment. To provide further support for the role of simulation in expanding distances for burdened

² The interaction between blindfold and burden was significant for this DV as well as for the normal distance measure: $F(1, 25) = 7.37, p = .01$.

participants, the next study attempts to show that in situations where no visual inputs are available and so no spontaneous simulation occurs, only deliberate simulation leads to distance expansion for burdened participants (H3).

4.2. Study 4: Expansion hinges on deliberate simulation for non-visible targets

As discussed in the introduction, distance expansion can occur as a result of either spontaneous or deliberate simulation. If a situation does not lead to spontaneous simulation, deliberate simulation must be present for simulation effects to occur. If simulation is indeed responsible for the expansion effect, then, we should only see expansion effects in circumstances that do not support spontaneous simulation when participants deliberately engage in simulation (H3). In other words, we'd expect an interaction between deliberate simulation and burden, such that only burdened participants *who are asked to simulate* judge distances to be farther away than do their non-burdened counterparts.

4.2.1. Methods

4.2.1.1. Design

The study was a 2 (burden) X 2 (simulation instructions) between subjects design. Participants wore either light or heavy backpacks. In addition, participant groups assigned to the simulation instructions condition were asked to imagine walking over to targets before giving their distance estimates.

4.2.1.2. Participants

Seventy five participants completed the study for payment. Participants completed the study in groups of up to six people, with each group being assigned to one of the four study conditions: high or low burden crossed with explicit instructions to simulate or no instructions to simulate.

4.2.1.3. Procedure

Participants completed a “going out to lunch” scenario, where they were asked to estimate distances to six different restaurants where they might sit down and have lunch. The instructions were similar to those used in the previous study.

The study took place at the university student center, which has a number of nearby dining places. Importantly, though close by, the restaurants we asked about were all not visible from the location of the study. This allowed us to ask participants about targets that were by nature not visible given the study’s setting. Given that targets were not visible, participants were instructed to skip distance estimation for targets the location of which they did not know or remember³.

After putting on the backpacks, participants walked approximately 100 feet from one end of the student center to another so that they could get a feel for the backpack weight. They then read their instructions and estimated distances to ten practice locations unrelated to food. This allowed them to get used to estimating distances and thereby eliminated some noise in our observations. Participants then estimated distances to the restaurants that served as our main targets. Importantly, the six restaurants were not visible from participants’ physical position during the study.

³ These totaled less than 10% of possible observations.

4.2.2. Results

A mixed ANOVA tested the impact of burden and instructions to simulate with target as a within-subject repeated measures variable and simulation instructions as a between subjects factor. Gender and the interaction of gender with burden were also included. The covariance structure was specified as heterogeneous compound symmetry.

Analysis indicated a significant interaction between simulation and burden, such that distance expansion only occurred for participants who were explicitly asked to imagine walking over to targets. The interaction term between burden and simulation was significant at the .05 level: $F(1, 66) = 5.66, p = .02$. Participants carrying light backpacks ($M = 204.65$) estimated similar distances to those carrying heavy backpacks ($M = 181.4$) when no explicit simulation instructions were given. When explicit instructions to simulate were employed, high burden participants estimated higher distances ($M = 247.43$) than those estimated by low burden participants ($M = 179.72$), $F(1, 66) = 4.01, p = .05$.

The figures below display effects using both measures from the previous study. Figure 3a shows expansion occurs only for simulation participants. Figure 3b shows the same result using the proportion between estimated and objective distance for each

target. Again, we see that all participants overestimate distances, with simulation leading to greater overestimation⁴.

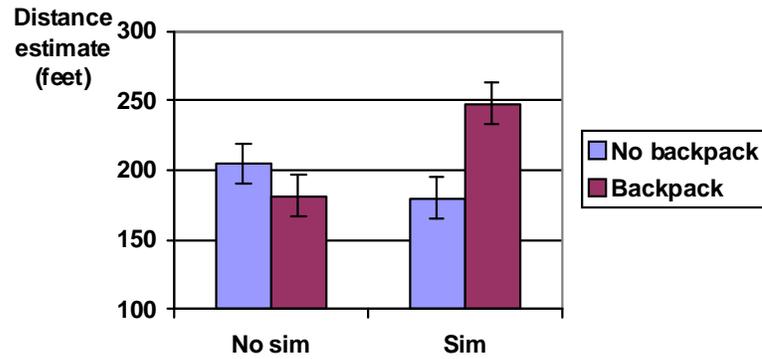


Figure 3a: No expansion for non-visible targets without deliberate simulation: distance

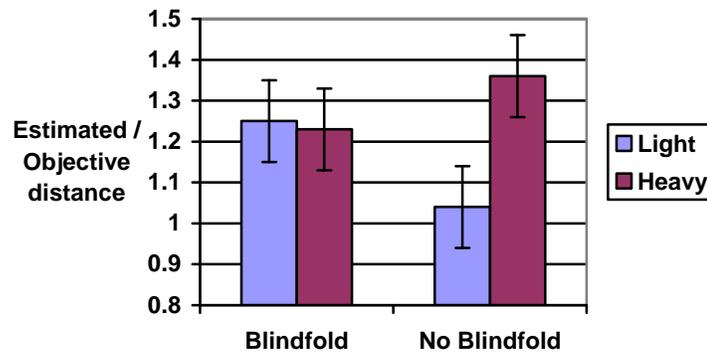


Figure 3b: No expansion for non-visible targets without deliberate simulation: distortion

⁴ The interaction between burden and simulation was significant with the distortion measure (distance relative to objective distance) as well as with the raw estimated distance measure used as a DV: $F(1, 66) = 4.97, p = .03$.

4.2.3. Discussion

As hypothesized, participants in an environment lacking in visual inputs did not exhibit the distance expansion effect. This lack of expansion in circumstances that theoretically make spontaneous embodied simulation difficult supports the importance of simulation in distance expansion.

Further evidence for the role of simulation in distance expansion is provided by the occurrence of distance expansion effects for participants who were asked to deliberately and consciously engage in simulating walking over to targets. Without deliberate simulation, no significant expansion occurred in this context where targets were not visible. With deliberate simulation, however, expansion did occur – showing the dependence of distance expansion on simulation. Accordingly, we found the anticipated interaction of physical burden and deliberate simulation instructions (H3).

Notably, in the studies presented in the current chapter the predicted pattern where expansion occurs only in circumstances supporting either spontaneous or deliberate simulation obtained using two different dependent measures. First, condition-dependent expansion was evident when looking at the patterns of raw estimated distances. Second, a similar pattern was evident looking at a measure of the distortion of distance estimation: estimated distance divided by the objective distance of targets. This second measure prevents an overweighting of far-away targets relative to close-by targets to ensure that the contingent expansion effects evident in the patterns produced when using raw estimated distance as a DV are not due to far-off targets only.

In sum, the current study demonstrated the role of deliberate simulation in generating distance expansion effects where spontaneous simulation is unlikely to occur due to lack of visual inputs. The next study attempts to provide convergent evidence for the role of simulation in estimates of acquisition costs by exploring another of the conditions for the occurrence of spontaneous simulation: the possibility for action.

5. Dependency of distance expansion effects of simulation: the possibility of action

5.1. Study 5: Simulation depends on the possibility for action: Reachability of targets

As stated earlier, if simulation is indeed the crucial component that makes targets appear farther away when burdened by heavy weight, expansion should not occur in conditions that preclude spontaneous simulation. One of the posited conditions that encourage spontaneous simulation is that action should be possible.

In the case of simulation of walking, walking to targets has to be possible for simulation of walking to occur. If walking to targets is not possible in a given situation, simulation of walking should not occur, and, consequently, distance expansion should not occur. As in the previous study, however, explicit instructions to imagine reaching should restore expansion.

To test this idea, the current study employed targets that are up in the air. Since one cannot walk to the target, there should be no simulation of walking in this case. Consequently, we expect no significant distance expansion. However, if participants were asked to imagine flying to reach targets, this deliberate simulation should restore distance expansion, producing an interaction of burden and simulation instructions (H3). Flying is not an action participants are actually capable of taking. However, they can still *imagine* flying, and would presumably borrow from possible actions to imagine this action, leading burden to have an effect similar to the one it would have on actual action.

5.1.1. Methods

5.1.1.1. Design

The design was a 2 (burden) X 2 (simulation instructions) between participants design. As before, different targets were used as repeated measures for distance estimation.

5.1.1.2. Procedure

Seventy five participants completed the study for payment in groups assigned to one out of the four conditions. The study took place inside and right outside the campus student center. Before beginning the distance estimation phase, participants put on the backpacks and walked from the study's gathering location to a location roughly 100 feet away.

Targets were naturally occurring objects in the study's location. These included different levels of the ceiling inside and outside the building, as well as the roofs of buildings that were visible from outside the building.

Simulation participants were asked to imagine flying over to each target before giving their distance estimate. Non-simulation participants were simply asked to estimate the distance to each target.

5.1.2. Results

The data was analyzed using a repeated-measures mixed model similar to those used in earlier studies. The covariance structure was specified as unstructured.

As expected, there was a significant interaction between burden and simulation: $F(1, 71) = 7.38, p = .008$. Specifically, expansion only occurred for participants who were explicitly instructed to engage in simulation. Without instructions to simulate, average estimated height was not statistically different between low burden participants ($M = 504.9$) and high burden participants ($M = 555.61$), $p > .2$. For participants who were asked to imagine themselves flying, however, the distance estimated by high burden participants ($M = 655.8$) was significantly higher than that estimated by low burden participants ($M = 1564.67$). The simple effect for the simulation condition was significant at the .001 level, $F(1, 71) = 8.76, p = .004$.

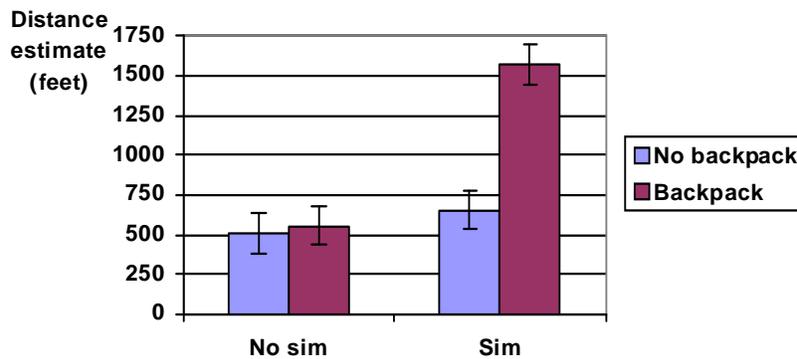


Figure 4: Unreachable objects expand given deliberate simulation

5.1.3. Discussion

With no explicit instructions to simulate getting to non-reachable targets, we expected no spontaneous action simulation of walking over to targets would occur,

since walking over was not possible. Supporting this prediction, we found no distance expansion when targets were above and could not be walked to. However, for participants who were encouraged to simulate an action alternative to walking that would allow reaching targets, distance expansion did occur, supporting the role of simulation in obtaining the distance expansion effect. Notably, the imagined action was not a realistic one: participants imagined flying to targets. It seems, then, that participants borrow from known actions in imagining fanciful actions, leading simulation to have similar effects in cases of fanciful and realistic action.

6. Comparing the effects of spontaneous and deliberate simulation

6.1. Study 6: Expansion Effects Depend on Simulation

The previous studies have demonstrated that burdened participants only estimate distances as longer in circumstances that either support spontaneous simulation (studies 2-3) or encourage participants to engage in deliberate simulation (studies 4-5). However, the studies did not examine whether deliberate and spontaneous simulation can work in tandem. In other words, can the two types of simulation have cumulative effects, or are the effects of simulation exhausted by the presence of one simulation type such that the occurrence of the other type of simulation does not add to simulation effects? The current study is designed to answer this question.

In addition to testing their additivity, the study also compares the magnitude of effects of explicit, deliberate action simulation and spontaneous action simulation given conditions conducive to spontaneous simulation. Such a comparison may reveal the extent of simulation that occurs naturally, without instructions to deliberately imagine walking to targets. If spontaneous simulation occurs but not for all people at all times, then even given conditions that support spontaneous simulation, expansion effects may be weaker under conditions that do not call for deliberate simulation.

It might also be that deliberate simulation produces effects that are inherently more powerful than those of spontaneous simulation. In much of the research regarding spontaneous simulation in cognitive psychology, simulation has been treated

as an implicit, non-conscious process (Barsalou 2003; Niedenthal et al. 2005). If this is the case, it may well be that the conscious, vivid experience of simulating given by deliberate simulation produces stronger effects than does spontaneous simulation.

The study also aims to tie the findings of prior experiments together in a single setting. Specifically, the study aims to demonstrate that the findings from studies 2 (interaction of burden with visibility) and 3 (interaction of burden with deliberate simulation where targets are *not visible*) can occur together in a single setting. This would help solidify the ideas supported by those studies, supporting out interpretation of the studies that previously hinged on the assumption that the two settings used for those studies were functionally equivalent.

Rather than testing expansion and simulation in separate settings, the study employs a fully crossed 8-cell design that includes all conditions explored in studies 1 and 2, in addition to a visible targets condition that incorporates instructions for deliberate simulation. The latter condition should evoke both spontaneous and deliberate simulation. This design allows not only replication of previous results in a unified setting, but testing the hypothesis that deliberate simulation adds to distance expansion beyond spontaneous simulation. This might happen because spontaneous simulation may not occur for all participants at all times, or, even if it does occur, might be weaker than deliberate simulation in its effects. To reiterate the logic of weaker expansion effects when contingent on spontaneous simulation, even in circumstances conducive to simulation only a subset of respondents may simulate walking over to targets. Accordingly, instructions to simulate should produce more extensive expansion effects than spontaneous simulation driven by the situation alone.

As with the nonvisible targets used in study 2, we predict that participants wearing a blindfold would not engage in spontaneous embodied simulation, and so would not display distance expansion effects. However, given that simulation leads to distance expansion, blindfolded participants that deliberately engaged in simulation of walking *should* display expansion effects.

To summarize, we predict expansion effects for non-blindfolded participants that do not deliberately engage in simulation, and potentially stronger expansion effects for participants who engage in deliberate simulation. For blindfolded participants, we predict no expansion when no instructions are given to simulate walking over to targets (since no spontaneous simulation would occur without visibility). When simulation is explicitly encouraged, we predict that blindfolded participants would display distance expansion. In other words, we expect blindfolded participants to display distance expansion effects (i.e., for heavy burden participants to estimate distances as greater than light burden participants do) only under conditions where they deliberately imagine themselves walking over to targets before giving their distance estimations, and participants who could see targets to display stronger distance expansion effects under explicit instructions to simulate.

Table 1 below gives the pattern of predictions across conditions.

Table 1: Predictions across conditions

Deliberate simulation inst.	Visibility	Predicted burden effect
No	Paths visible	Expansion
No	Paths not visible	No Expansion
Yes	Paths visible	Expansion
Yes	Paths not visible	Expansion

6.1.1. Methods

6.1.1.1. Design

The study was a 2 X 2 X 2 between subjects full-factorial design. Factors were 2 (heavy or light backpack) X 2 (targets visible or blindfold) X 2 (explicit instructions to simulate or not).

6.1.1.2. Procedure

A total of 122 participants completed the study for payment. The study took place in groups of between one and six participants. Each group was assigned to one of the eight study cells

Participants started the study at the business school's behavioral lab, a few hundred feet from the study's location. To arrive at the location where they'd estimate distances, participants had to both walk and climb stairs, which allowed them to have some experience walking with the backpacks and so feel the weight assigned to them

prior to beginning distance estimation. The location of the study was the sidewalk of the street just outside the business school. Figure 3 shows a map of the location.

Participants in non-visible conditions were asked to wear a blindfold for the duration of the study. These participants wrapped folded bandanas over their eyes after arriving at the location of the study and receiving initial instructions. The blindfolds were applied in a manner that allowed participants to see down to the questionnaires they held on clip-boards but not horizontally in front of them. Experimenters ensured that blindfolds were applied properly.

In addition to having light or heavy backpacks and being assigned to different visibility conditions, participant groups were either instructed to estimate distances (No-Simulation, or NoSim conditions), or to imagine themselves walking over to each target before giving their estimates (Simulation, or Sim conditions). To try to ensure simulation participants actually engaged in simulation, the importance of this instruction was stressed in both written and verbal form. In addition, as part of a battery of control questions given at the end of the questionnaire participants were asked to what extent they'd imagined themselves walking over to targets¹.

Once at the study location, participants were instructed to remain standing for the duration of the study. The experimenter pointed out several of the study's targets in order to familiarize participants with the environment prior to applying the blindfolds. Several of the targets (e.g., the law school, the student center) were well-known landmarks and so likely familiar to all participants. As before, participants were instructed to skip targets the location of which they did not know. These

¹ This measure produced no significant effects and is thus precluded from analysis.

instructions and familiarization phase were particularly important for blindfolded participants, who essentially had to estimate distances from memory.

Each participant gave 16 distance estimates for targets visible from the study's location. In this study distances were reported on close-ended scales ranging from 0 feet to 1 mile (5280 feet), with a translation to metric units for participants who were more familiar with that measuring system.

6.1.2. Results

One participant was removed from the sample since his observations were extreme outliers (beyond 3 SD from the mean average distance estimate). This left 121 participants in our sample across the 8 cells of a 2 X 2 X 2 design. .

Data was analyzed using a repeated measures mixed model ANOVA with target as the repeated measure. The model included the 3 factors (Weight, Vis, and Sim) as well as their interactions, in addition to gender and its interaction with burden. The covariance was specified as unstructured. Table 2 below displays results from this analysis.

Table 2: Tests of fixed effects (type 3) for study 6

Effect	Num DF	Den DF	F Value	Pr > F
i	15	98	21.67	<.0001
Vis	1	98	18.28	<.0001
Sim	1	98	0.06	0.8052
Vis*Sim	1	98	4.78	0.0312
W	1	98	1.97	0.1637
Vis*W	1	98	1.53	0.2197
Sim*W	1	98	0.28	0.5980
Vis*Sim*W	1	98	4.51	0.0361
Fem	1	98	2.02	0.1583
W*Fem	1	98	11.63	0.0009

The predicted 3-way interaction effect between burden, visibility and explicit simulation instructions was significant: $F(1, 98) = 4.51, p = .03$. The pattern underlying this interaction corresponded to expectations (see figure 5 below). In the absence of explicit simulation instructions burden produced directional expansion effects for participants who could see the targets but not for participants who could not see the targets. Explicit simulation instructions, however, made it so both blindfolded and non-blindfolded participants displayed directional expansion effects due to burden. This is consistent with simulation underlying the expansion effect and occurring naturally in visible, but not in blind, conditions. Accordingly, in blindfold conditions explicit instructions to simulate were required to produce an expansion effect. The only significant effect was the large expansion effect evident for blindfolded participants who engaged in deliberate simulation: $F(1, 98) = 7.87, p < .01$. Other simple effects were not significant.

Notably, deliberate simulation participants displayed markedly higher expansion effects in the visible condition. Expansion effects obtained through deliberate simulation under the blindfold condition were stronger than those obtained under spontaneous-simulation supporting conditions as well. This supports a greater

effect for deliberate, over spontaneous simulation, at least under conditions where no visual inputs are available.

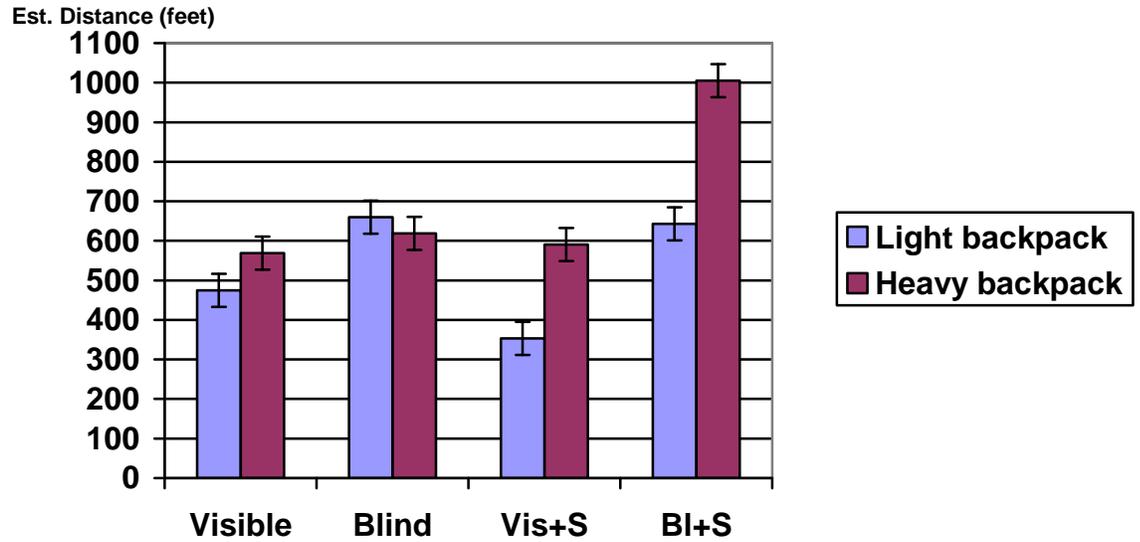


Figure 5: Expansion occurs only with visible targets or deliberate simulation

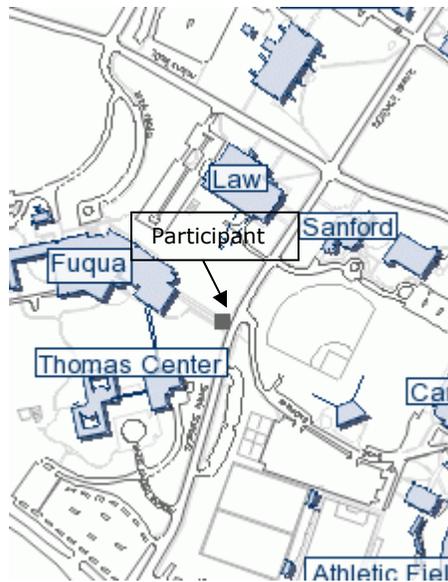


Figure 6: Map of study area

6.1.3. Discussion

In the current study, expansion effects were absent for blindfolded participants who were not explicitly asked to engage in simulation. As with the non-visible targets in study 2, blindfolded participants displayed distance expansion effects only when deliberately asked to engage in simulation. This is because the lack of visual input regarding targets ostensibly precludes the occurrence of spontaneous simulation.

Two further results from the current study are of note. First, distance expansion effects for participants who could see targets but were not explicitly asked to simulate walking over to targets were weaker than those found in study 2² and weaker than those evident for participants who could see target and were also asked to simulate walking over to targets.

² This may occur in cases where there is limited motivation to walk to the target. It may be that for embodied simulation to spontaneously occur, a motivation to engage in action is required. Prior unreported studies both in this line of research and in Proffitt's (Witt et al. 2004; 2005) support the notion of motivation moderating the effects of burden on distance perception. The motivational draw of a target may, accordingly, moderate the occurrence and therefore the effects of spontaneous simulation, but is unlikely to have an effect on deliberate simulation, which hinges on intent to simulate rather than on the motivational value of targets.

Given that participants may have different propensities to act, inducing deliberate simulation might lead to expansion effects that go beyond those occurring without deliberate simulation. This is because even in situations supporting spontaneous embodied simulation, only some participants might spontaneously engage in simulation, due to lack of motivation to engage in action, whereas where simulation is deliberately encouraged, participants who'd otherwise not be inclined to engage in simulation would engage in simulation regardless of personal motivation and inclination. Consequently, if simulation is indeed responsible for the expansion effect, deliberate simulation participants should show even greater expansion effects than those displayed by spontaneous simulation participants.

This enhancement of simulation effects for deliberate over spontaneous simulation should be particularly true in a setting such as that of the current study, where targets are devoid of motivation. Unlike the food targets of the prior studies, targets in the current study were just arbitrary targets found in the study's environment, without mention of food. Such targets would be devoid of motivational draw for most participants and so may produce reduced expansion effects in spontaneous simulation conditions when compared to the motivationally relevant targets employed in most prior studies. Because of the lack of motivational value for targets in the current study, we can presume that only some participants in visible/no-simulation conditions engaged in spontaneous simulation, leading to weak expansion effects. The comparative results of spontaneous, vs. deliberate, simulation, might be different in settings where targets possess some motivational draw.

Weaker expansion effects for spontaneous, over deliberate, simulation could be either due to deliberate simulation intrinsically producing stronger effects than spontaneous simulation in general, or due to only some participants engaging in spontaneous embodied simulation. Importantly, deliberate simulation was predicted to lead to stronger expansion effects in any event, because without explicit instructions to simulate simulation might not spontaneously occur for all participants even in that support its occurrence. The tendency to engage in simulation might vary among participants such that only some participants spontaneously go through the process of simulation even given supportive circumstances. Accordingly, the present study provides evidence that the effects of deliberate simulation are over and above those spontaneous simulation, at least in conditions where visual inputs are missing, potentially allowing greater distortion.

7. Simulations effects on judgment: Implications and extensions

Consumer choice is traditionally seen as a balancing of costs and benefits (Bettman 1979). Faced with higher acquisition costs, consumers are less likely to pursue a purchase (Ratchford 1982). However, consumers often lack precise information about acquisition costs and as a consequence have to estimate such costs. If such estimates were more or less accurate they would provide a useful guide for consumer decision making. However, to the extent that such estimation processes are susceptible to biases, the process whereby consumers make subjective estimates of such costs deserves particular attention. The current work focuses on the effects of one such process on acquisition cost estimates – mental action simulation.

Simulations anticipate the experience of product acquisition given the consumer's current state and environmental context. Such simulated experience can alter consumers' view of the product and of the costs involved in its acquisition. The effects of factors that might otherwise not be considered become apparent in action simulation, and this can influence subsequent judgment.

The central effect of simulations which was the focus of the current work stems from their incorporating consumers' current physical state. Physical state influences the course of the simulated experience, which alters consumers' projections regarding the acquisition costs they face. For instance, a person wearing a heavy backpack finds the imagined experience of walking more effortful than would an unencumbered person. This would lead to enhancement in subsequent judgments of distance.

Confirming this reasoning, we found that in situations where consumers spontaneously (studies 2-3) or deliberately (studies 4-6) engage in simulation of product acquisition, their physical state has a systematic influence on their estimates of acquisition costs. Specifically, consumers who simulate walking over to a food item (study 2) or restaurant (studies 3-4) judge targets to be farther away when carrying a heavy backpack. This enhancement of estimated acquisition costs leads to shifts in preference away from targets that are an unspecified distance away (study 1).

Simulations can be either deliberate and intentional, or spontaneous. Deliberate simulations are ones participants engage in out of conscious intent. Spontaneous simulations, on the other hand, are simulations that are triggered by the situation. Accordingly, simulations were manipulated either directly through instructions to simulate, or indirectly through changing the environment such that spontaneous simulation was more or less likely to arise (e.g., blindfolding participants in study 2 to reduce the likelihood of simulation). Both deliberate and spontaneous simulation led to the incorporation of physical state in judgment and so produced expansion effects, though it appears that deliberate simulation may produce effects that are stronger than those of spontaneous simulation (study 6).

The current work discussed two particular conditions required for the spontaneous occurrence of simulation. First, consumers need to have visual inputs of products to simulate interaction with them. Second, action needs to be possible for it to be spontaneously simulated. Accordingly, we found that simulations, and consequent distance expansion, do not occur when inputs about the environment are lacking (studies 3-4, 6) and when targets are not reachable and so cannot be walked

over to (study 5). Because under such conditions consumers may have more difficulty spontaneously simulate walking to targets, burden has less influence on distance estimates.

Deliberate simulation of walking to targets can lead to distance expansion even when conditions do not support spontaneous simulation. Accordingly, in situations that do not support spontaneous simulation, we found distance expansion effects only for participants who were instructed to simulate walking over to targets (studies 4-6).

When neither spontaneous nor deliberate simulation is evoked by the situation, no expansion effects occurred (studies 3-6). Accordingly, our findings supported the hypothesized role of action simulation in leading consumers' current physical state to influence distance estimations.

Overall, the studies demonstrated that in estimating distances to various targets, consumers are affected by the process of simulating walking over to targets. Following simulation, targets are estimated as being farther away if consumers making the judgments are carrying a heavy burden. More generally, through simulation, physical states that make walking more effortful would make targets appear farther away, and physical states that make walking less effortful would likely make targets appear closer. Such effects have been previously demonstrated in psychology (Proffitt 2006), but their dependence on the conditions leading to a process of action simulation is a novel contribution of the current investigation.

On a broader level, the research suggests that simulation can be either a spontaneous or a deliberate process. The current investigation has also revealed the process of spontaneous, unintentional simulation operates in day-to-day purchase

situations and is accordingly relevant in consumer behavior. Farther, it suggests that simulation, through its incorporation of consumers' current physical state, leads to predictable effects on judgment. We expand on the possibilities of this general theory below.

7.1. Extensions and Contributions

Theoretically, the judgment of any product dimension the experience of which would be altered by consumers' physical state could be influenced by simulation. Different physical states can alter the simulated experience of product acquisition on a variety of dimensions, consequently leading to corresponding alterations in judgment. For example, burden might make objects appear heavier and harder to transport because carrying additional items would feel more effortful when already burdened. Tiredness may make assembly and operation of a device seem more complex. A food-item should appear tastier to hungry consumers following simulation of eating the product because food tastes better when hungry, and so simulated eating should "feel" tastier when hungry. And a tool could be judged as less wieldy and easy to use if a consumer has busy hands, because using the tool in the current state would be more difficult. If such estimates operate similarly to distance estimates, they should depend on the occurrence of simulation.

This reasoning suggests that some findings of prior research may depend on simulations, and so be restricted to situations supporting simulation. For instance, the effects of visceral states on consumer judgments may hinge on consumers simulating product use while in their current state (Ariely & Loewenstein 2006; Loewenstein &

Schkade 1999). For instance, Reed and van Leeuwen's (1998) hungry participants tended to choose less healthy food for future consumption than did non-hungry participants, neglecting to consider that their current state of hunger was a temporary one. Such effects might have depended on participants' simulating eating the food alternatives while making their choices. Hungry participants would have had a more satisfying simulated eating experience than did non-hungry participants, which would have led them to choose the unhealthy food more often.

More generally, people's biased judgments of foods may also depend on the occurrence of simulation (Wansink 2007). If, for example, being hungry makes food items appear smaller or seem to contain fewer calories, this effect might well depend on simulation. For example, simulation of eating when hungry may subjectively lead a given quantity of food eaten to feel like less food, since when hungry you require more sustenance and therefore any portion is subjectively smaller, relative to your needs, than it would otherwise be. Similarly, when a consumer is tired, energy drinks should be judged to provide less energy following simulation because subjectively they provide less energy. Without simulation, though, such biasing effects of hunger on judgment of food items may not occur.

Conditions different than physical state might also affect the course of simulations of product interactions, and influence subsequent judgments. Given the situated nature of simulations, conditions other than physical state should also be incorporated in simulation. If these affect the simulated experience, related judgments should be affected.

For instance, being emotionally distraught may make operation of a product more difficult. Accordingly, simulations of operating a product when distraught would make operation of a product seem more difficult. Judgment of the ease of operation of a product should accordingly be affected so that a product is judged as more difficult to operate following simulation of operating it when distraught.

Similarly, being happy may generally make experiences more pleasurable. For instance, playing a video-game while in a good mood may be more enjoyable than playing the same video game while not in a good mood. Accordingly, simulations of playing a video game while happy may make it seem more enjoyable than it would otherwise. As a consequence, a video game may be judged as more enjoyable following simulation of playing it conducted when a person is happy.

In addition to delineating conditions for previously explored effects of transitory states on judgment and suggesting further effects of transitory state that extend to situations where actual experience is absent, the current research adds to previously uncovered effects of simulation. Prior research has pointed that simulation leads to a variety of positive effects on product judgment, including enhanced involvement and positive attitude (Escales 2004; Philips 1996). Prior research has revealed that simulations can create general positive attitudes towards products (Tal et al. 2009). The current work shows that simulations can also have particular and predictable effects on particular product-related judgments.

A further contribution of the current research lies in its discussion of spontaneously occurring simulation. Prior research in consumer behavior has tended to focus on simulation as a deliberate process (e.g., Escales 2004; Philips 1996). The

current work shows that spontaneously occurring simulations such as those discussed in the cognitive psychological literature also have a bearing on consumer behavior.

The effects of simulation on consumer judgment, then, can be far-ranging. Consumer simulation of product acquisition and interaction may supply a basis for consumers to see products differently based on the experience of the product in simulation. Future research should explore the breadth and limits of these effects.

Importantly, simulation effects on judgment may in turn have implications for marketing practitioners. We discuss these below.

7.2. Implications

The influence of simulation on judgment and choice has implications for both marketers and consumers. From a marketing perspective, past research has tended to highlight the positive impact of simulation. Simulation of product use has been linked to deepened involvement and enhanced positive attitudes towards the brand (Philips 1996)¹. The current research, however, indicates that simulation may also have particular effects on estimation and judgment of particular product properties. Such effects reflect the influence of current physical states, which might not apply at the actual time of consumption. Importantly, such effects may be detrimental, from a marketer's perspective

Simulation's effects on distance estimates are important for consumer choice since higher distances mean higher acquisition costs, and may well lead to preference

¹ Though note that these positive effects have been demonstrated for intentional, rather than spontaneous, simulation, and may not occur in cases where only spontaneous simulation occurs.

reversals such as those demonstrated in study 1 (Bell et al. 1998; Cadwallader 1975; Nelson & Simmons 2009). Consumers may be willing to go only up to a certain distance for any given purchase, and so are more likely to forego purchase or opt for a different option when targets are perceived as farther away.

As an example, consider a consumer at a strip mall considering whether they want to visit another store they can see at the other end of the mall. When burdened by heavy shopping bags, the spontaneous simulation triggered by visual inputs would lead the consumer to judge the store as being farther away. If the consumer is only willing to travel 500 feet, but the store is perceived as being 1,000 feet away, they would forego the additional shopping.

As discussed in the previous section, simulation may effect judgment of other product dimensions such as product volume and ease-of-use. Judgmental effects that reduce product desirability on dimensions other than distance could lead consumers to forego purchases when burdened or to shift preferences away from affected alternatives. As with distance, this may be particularly true when judgments are brought below a cut-off point for a particular attribute.

Given its potential affect on other judgment dimensions (see below), simulation may have implications that go beyond preference formation. If simulation affects judgment of product dimensions such as taste and efficacy, it might in turn lead to confirmatory processing such that products are experienced in a manner that confirms judged product properties. In other words, if a person expects a product to be more thirst-quenching, they may experience it as such. This is in accordance with a vast literature showing fulfillment of expectations in experience (Lee et al. 2006;

Ragunathan et al. 2006; Shiv et al. 2005). Such fulfillment of expectations in product experience may in turn lead to alterations in product satisfaction. This may subsequently dictate repeat purchase behavior, word-of-mouth, and a variety of other important marketing outcomes.

It's important for marketers' to consider that simulation may have some detrimental effects on product judgment, rather than being wholly positive. Accordingly, whereas in some circumstances it may be beneficial to encourage consumers to simulate, in others it may be better to avoid encouraging simulation so as to not adversely affect judgment. Conversely, in some situations action simulation may in fact contribute to a product's judgment. For instance, simulating eating while hungry is likely to make food items appear tastier. Thus, marketers may in some cases wish to encourage simulation by revealing or hiding direct visual information about an item (e.g., transparent package, picture of product on sign or ad), or explicitly encourage consumers to "imagine themselves in the product" (Escales 2003).

Consumers should also be aware of the biasing effects of simulation on judgment. The effects of simulation on judgment may be adaptive in that they can help consumers anticipate the effects of current physical state on product acquisition and experience. If current physical state would alter subjective experience upon actual action, it is adaptive for judgment to reflect these effects.

However, simulation incorporates consumers' physical state as it is *right now* in judgment even if the current state would not be relevant when actually performing the action. Simulation may ignore the fact that current physical states may not apply to the timing of actual action, and can consequently exert a biasing influence on

judgment. This could lead to the types of effects discussed by Loewenstein (1996; Read and Van Leeuwen 1998), where current visceral states distort judgment of items that would not be consumed while in the same visceral state. In other words, for some judgments, the timing of judgment and actual action may differ such that current physical state has no bearing on the actual experience of product acquisition or consumption. In such cases, having current physical state influence judgment would constitute a biasing influence.

To avoid the biases brought about by simulation, consumers may want to make product judgments in situations where they are not directly faced with an item so that action is not immediately possible and vivid representations are not available. For instance, they might want to prepare a shopping list at home versus making decisions when in front of the products. Alternately, judgment should be conducted in situations that parallel consumption situations such that simulation produces adaptive influences on judgment.

Appendix: Analysis Results

Study 1 analysis

Effect	Num DF	Den DF	F Value	Pr > F
W	1	51	1.27	0.2641
i	4	51	12.73	<.0001

Study 2 analysis

Effect	Num DF	Den DF	F Value	Pr > F
W	1	12	5.84	0.0325
i	20	257	25.93	<.0001

Study 3 analysis - distance

Effect	Num DF	Den DF	F Value	Pr > F
Blind	1	25	5.98	0.0219
W	1	25	2.03	0.1663
Blind*W	1	25	8.29	0.0080
fem	1	25	3.02	0.0948
Blind*fem	1	25	4.00	0.0564
W*fem	1	25	0.44	0.5150
Blind*W*fem	1	25	15.44	0.0006
i	12	382	8.52	<.0001

Study 3 analysis - distortion

Effect	Num DF	Den DF	F Value	Pr > F
Blind	1	25	6.10	0.0207
W	1	25	0.01	0.9258
Blind*W	1	25	7.37	0.0118
fem	1	25	1.37	0.2521
Blind*fem	1	25	3.33	0.0799
W*fem	1	25	0.59	0.4507
Blind*W*fem	1	25	6.22	0.0196
i	12	382	3.22	0.0002

Study 4 analysis - distance

Effect	Num DF	Den DF	F Value	Pr > F
W	1	66	0.32	0.5759
Sim	1	66	1.85	0.1788
W*Sim	1	66	5.66	0.0202
Fem	1	66	0.00	0.9470
W*Fem	1	66	1.63	0.2061
Sim*Fem	1	66	6.35	0.0141
W*Sim*Fem	1	66	3.31	0.0735
i	4	278	11.71	<.0001

Study 4 analysis - distortion

Effect	Num DF	Den DF	F Value	Pr > F
W	1	66	0.38	0.5410
Sim	1	66	0.38	0.5382
W*Sim	1	66	4.97	0.0292
Fem	1	66	0.13	0.7239
W*Fem	1	66	0.27	0.6025
Sim*Fem	1	66	2.13	0.1488
W*Sim*Fem	1	66	0.28	0.5977
p1	4	278	6.78	<.0001

Study 5 analysis

Effect	Num DF	Den DF	F Value	Pr > F
--------	-----------	-----------	---------	--------

fly	1	71	0.47	0.4961
w	1	71	2.38	0.1271
fly*w	1	71	7.38	0.0083
i	5	71	8.30	<.0001

References

- Anzola, G. P., G. Bertoloni, H.A. Buchtel and G. Rizzolatti (1977), "Spatial Compatibility and Anatomical Factors in Simple and Choice Reaction Time," *Neuropsychologica*, 15, 295-302.
- Ariely, Dan, and George Loewenstein (2006), "The Heat of the Moment: The Effect of Sexual Arousal on Sexual Decision Making," *Journal of Behavioral Decision Making*, 19, 87-98.
- Barsalou, Lawrence W. (2003), "Situated simulation in the human conceptual system." *Language and Cognitive Processes*, 18, 513-562.
- Bell, David R., Teck-Hua Ho, and Christopher S. Tang (1998), "Determining where to Shop: Fixed and Variable Costs of Shopping," *Journal of Marketing Behavior*, 35(3), 352-369.
- Bettman, James R. (1979), *An Information Processing Theory of Consumer Choice*, Reading, MA: Addison-Wesley Publishing Company.
- Blais, Christina A., Marie Panghorn Rose, Nemat O. Borhani, May M. Ferrell, Ronald J. Prineas, and Brian Laing (1986), "Effect of Dietary Sodium Restriction on Taste Response to Sodium Chloride: A Longitudinal Study," *The American Journal of Clinical Nutrition*, 44, 232-243.
- Borghgi, Anna M., Arthur M. Glenberg, and Michael P. Kaschak (2004), "Putting Words in Perspective," *Memory & Cognition*, 32(6), 863-873.
- Brooks, Charles M., Patrick J. Kaufmann, and Donald R. Lichtenstein (2004), "Travel Configuration on Consumer Trip-Chained Store Choice," *Journal of Consumer Research*, 31(3), 241-248.
- Brunner, James A., and John A. Mason (1968), "The Influence of Driving Time Upon Shopping Center Preference," *Journal of Marketing*, 32(1), 57-61.
- Cabanac, Michel (1979), "Sensory Pleasure," *The Quarterly Review of Biology*, 54(1), 1-29.
- Caldwallader, Martin T. (1975), "Cognitive Distance in Intraurban Space," in *Environmental Knowing: Theories, Research, and Methods*, Moore, Gary T., and Reginald G. Golledge (Eds.), 316-324, Stroudsburg, PA: Dowden, Huchingson & Ross.

- Escales, Jennifer Edson (2004), "Imagine Yourself in the Product: Mental Simulation, Narrative Transportation, and Persuasion," *Journal of Advertising*, 33(2), 37-48.
- _____, Luce, Mary-Francis (2004), "Understanding the Effects of Process versus Outcome-Focused Thought during Advertising," *Journal of Consumer Research*, 31(2), 274-285.
- Fischer, Martin H., and Christoph D. Dahl (2007), "The Time Course of Visuo-Motor Affordances," *Experimental Brain Science*, 176, 519-524.
- Gibson, James J. (1979), *The Ecological Approach to Visual Perception*, Boston, MA: Houghton Mifflin Harcourt.
- Glenberg, Arthur M., and Michael P. Kaschak (2002), "Grounding Language in Action," *Psychonomic Bulletin & Review*, 9(5), 558-565.
- Gollwitzer, Peter M. (1999), "Implementation intentions: Strong Effects of Simple Plans," *American Psychologist*, 54, 493-503.
- Grezes, J., M. Tucker, J. Armony, R. Ellis, and R. E. Passingham (2003), "Objects Automatically Potentiate Action: An fMRI Study of Implicit Processing," *European Journal of Neuroscience*, 17, 2735-2740.
- Handy, Tod C., Scott T. Grafton, Neha M. Shroff, Sarah Ketay, and Michael S. Gazzaniga (2003), "Graspable Objects Grab Attention when the Potential for Action is Recognized," *Nature Neuroscience*, 6, 1-7.
- Herrmann, Robert O., and Leland L. Beik (1968), "Shoppers' Movements Outside their Local Retail Area," *Journal of Marketing*, 32(4), 45-51.
- Hornik, Jacob, (1984), "Subjective vs. Objective Time Measures: A Note on the Perception of Time in Consumer Behavior," *Journal of Consumer Research*, 11 (2), 615-618.
- Hubbard, Raymond (1978), "A Review of Selected Factors Conditioning Consumer Travel Behavior," *Journal of Consumer Research*, 5(2), 1-21.
- Huff, David L. (1964), "Defining and Estimating a Trading Area," *Journal of Marketing*, 28(3), 34-38.
- Jeannerod, Marc (2001), "Neural simulation of action: A unifying mechanism for motor cognition," *Neuroimage*, 14, S103-109.
- Johnson, Scott H. (2000), "Thinking Ahead: The Case for Motor Imagery in Prospective Judgments of Prehension," *Cognition*, 74, 33-70.

- Kang, Yong-Soon, Paul M. Herr, and Christine M. Page (2003), "Time and Distance: Asymmetries in Trip Knowledge and Judgment," *Journal of Consumer Research*, 30(2), 420-429.
- Kostecki, Michel (1996), "Waiting Lines as a Marketing Issue," *European Management Journal*, 14(3), 295-303.
- Krishna, Aradhna, Rongrong Zhou, and Shi Zhang. (2008), "The Effect of Self-Construal on Spatial Judgments," *Journal of Consumer Research* 35(2), 337-348
- Leclerc, F., Schmitt, B. H., & Dubé, L. (1995) "Waiting Time and Decision Making: Is Time like Money?" *Journal of Consumer Research*, 22(1), 110-119.
- Loewenstein, George (1996), "Out of Control: Visceral Influences on Behavior," *Organizational Behavior and Human Decision Making*, 65(3), 292-272.
- Loewenstein, George, and David A. Schkade (1999), "Wouldn't it Be Nice? Predicting Future Feelings," in D. Kahneman, E. Diener & N. Schwartz (Eds.), *Well Being: The Foundations of Hedonic Psychology*, Russell Sage Foundation.
- MacKay, David B., and Richard W. Olshavsky (1975), "Cognitive Maps of Retail Locations: An Investigation of Some Basic Issues," *Journal of Consumer Research*, 2, 197-205.
- Mobini, Sirous, Lucy C. Chambers, and Martin R. Yeomens (2007), "Effects of Hunger State on Flavour Pleasantness Conditioning at Home: Flavour–Nutrient Learning vs. Flavour–Flavour Learning," *Appetite*, 48(1), 20-28.
- Morwitz, Vicki G. (1997) "It Seems Like Only Yesterday: The Nature and Consequences of Telescoping Errors in Marketing Research," *Journal of Consumer Psychology*, 6(1), 1-30.
- Nelson, Leif D., Joseph P. Simmons (2009), "On Southbound Ease and Northbound Fees: Literal Consequences of the Metaphoric Link between Vertical Position and Cardinal Direction," *Journal of Marketing Research*, forthcoming.
- Niedenthal, Paula, Lawrence W. Barsalou, Piotr Winkielman, Silvia Krauth-Gruber, and Francois Ric (2005), "Embodiment in Attitudes, Social Perception, and Emotion," *Personality and Social Psychology Bulletin*. 9(3), 184-211.
- Pham, Lien, and Shelley E. Taylor (1999), "From Thought to Action: Effects of Process- Versus Outcome-Based Mental Simulations on Performance," *Personality and Social Psychology Bulletin*, 25(2), 250-260.
- Philips, Diane (1996), "Anticipating The Future: The Role of Consumption Visions in Consumer Behavior," *Advances in Consumer Research*, 23, 70-75.

- Proffitt, Dennis R. (2006), "Embodied perception and the economy of action," *Perspectives on Psychological Science*, 1(2), 110-122.
- Proffitt, Dennis R., Jeanine Stefanucci, Tom Banton, and William Epstein (2003), "The Role of Effort in Perceiving Distance," *Psychological Science*, 14(1), 106-112.
- Raghubir, Priya, and Aradhna Krishna (1996), "As the Crow Flies: Bias in Consumers' Map-Based Distance Judgments," *Journal of Consumer Research*, 23(1), June, 26-39.
- Ratchford Brian T. (1982), "Cost-benefit Models For Explaining Consumer Choice and Information Seeking Behavior," *Management Science*, 28(2), 197-202.
- Read, Daniel, and Barbara VanLeuwen (1998), "Predicting Hunger: The Effects of Appetite and Delay on Choice," *Organizational Behavior and Human Decision Making*, 76(2), 189-205.
- Rindfleisch, Aric and Jan B. Heide (1997), "Transaction Cost Analysis: Past, Present, and Future Applications," *Journal of Marketing*, 61 (1), 30-54.
- Schwartz, B. (1975), *Queing and Waiting*, Chicago, IL: University of Chicago Press.
- Symes, Ed, Rob Ellis, and Mike Turner (2007), "Visual Object Affordances: Object orientation," *Acta Psychologica*, 124, 238-255.
- Tal, Aner, Abhijit Guha, Daniel Lieb and Joel Huber (2009), "Mental Simulation and the Evaluation of Hedonic Consumption," working paper.
- Taylor, Sheylly E., Lien B. Pham, Inna D. Rivkin, and David A. Armor (1998), "Harnessing the Imagination: Mental simulation and self-regulation of behavior," *American Psychologist*, 53, 429-439.
- Tucker, Mike, and Rob Ellis (1998), On the relations between seen objects and components of potential actions, "*Journal of Experimental Psychology: Perception and Human Performance*, 24(3), 830-846.
- Wansink, Brian (2007), *Mindless Eating*, New York, NY: Bantam
- Witt, J.K., and Dennis R. Proffitt (in press), "Action-Specific Influences on Distance Perception: A Role for Motor Simulation," *Journal of Experimental Psychology: Human Perception and Performance*.
- _____, Dennis R. Proffitt., and William Epstein (2005), "Tool Use Affects Perceived Distance But Only When You Intend to Use It," *Journal of Experimental Psychology: Human Perception and Performance*, 31, 880-888.

Zverev, Yuri P. (2004), "Effects of Caloric Deprivation and Satiety on Sensitivity of the Gustatory System," *BMC Neuroscience*, 5(5), 1471-2202.

Biography

Aner Tal was born on 1979 in the city of Ramat-Gan, Israel. He attended the University of Tel-Aviv, where he studied Economics, Accounting, Philosophy, and Business Administration. He received his B.A. in Economics and Accounting in 1998, and an MBA with a major in Marketing in 2002. Since 2003 he has been a diligent PhD student at the Fuqua School of Business at Duke University, studying Consumer Behavior.

Aner has presented in a number of conferences and has several proceedings published in *Advances in Consumer Research*. He's also published "Time of Day Influence on Scale Reliability" in the journal *Marketing Letters*. He is currently working on several manuscripts based on studies completed during his PhD.

Aner has received a fellowship throughout his studies at Duke University. He has also been a Preparing Future Faculty Fellow at Duke, and graduated from his MBA Magna Cum Laude.

Additional personal and professional information can be found online.