

Understanding Real Estate Buyer Behavior through the use of Ocular Tracking Technology

by

Michael J. Seiler*
Professor and Robert M. Stanton Chair of Real Estate
Old Dominion University
2154 Constant Hall
Norfolk, VA 23529
mseiler@odu.edu
phone: (757) 683-3505
fax: (757) 683-3258

Poornima Madhavan
Old Dominion University
Department of Psychology

Molly Liechty
Old Dominion University
Department of Psychology

and

Liza Potts
Old Dominion University
Department of English

* Contact Author

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This study introduces a new science to the field of real estate known as ocular tracking technology. We track and record five measures of eye movements of current homebuyers who are in the process of searching for homes on the Internet. Total dwell time, fixation duration, and saccade amplitude are all found to significantly explain a buyer's willingness to pay for a home. We also test for the negative externality effects of having pink walls in the main living area of a home, and separately, the impact that having power lines too close to the home has on market values.

Key words: ocular tracking, behavioral real estate, negative externalities.

JEL Classifications: R20; R32; A12

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Introduction

While it is widely recognized that homebuyers are relying more and more on the use of the Internet to pre-search for homes, very little research has been undertaken to examine *how* people search for homes on the Internet. With the tremendous wealth of information about listed homes online, potential homebuyers must weigh the marginal search cost (time) of looking through thousands of additional properties against the marginal benefit of possibly finding the home that may be slightly better for them. If the number of available homes on the Internet was small, people would spend more time looking at each property. But with so many homes available, it is generally accepted that people spend very little time on a particular property – unless, of course, that property catches their eye. Therefore, it is up to the listing agent to post an eye-catching photograph of the home. Failure to attract attention with the first photo means likely never getting the chance to show the homebuyer a second, third, and fourth picture.

Most properties posted on the Web begin with a picture of the home from the front including the home and surrounding yard. We refer to this as the “curb appeal” of the home. If a buyer is physically walking up to the property, and the property lacks curb appeal, he will typically still agree to go inside and view the rest of the home since he has already invested the time to physically drive out to see the property. But, in cyberspace, if a home lacks curb appeal, homebuyers will not go in to see the rest of the home because moving on to the next property presents next to no effort at all. In light of the modern method for searching for homes, realtors cannot afford to list a property that lacks curb appeal.

So how does a listing agent know what constitutes good curb appeal? Moreover, how can you tell what people focus on when they take their first look at a home? In traditional survey

work, researchers refer to the difference between “stated preference” and “revealed preference.” A stated preference is what people *say* they prefer or *say* they would do in a certain situation. A revealed preference is what they *actually* do. Even a person who is completely honest might experience a divergence between a stated and a revealed preference. Therefore, in order to accurately assess user preferences, it is important to focus on physiological measures that go beyond simple verbalizations from the user. The purpose of this study is to quantify previously unknown data and thereby advance the field of real estate by helping understand the factors that drive homebuyer search processes on the Internet. To this end we will use ocular tracking technology that will enable us to track the exact scanning pattern employed by the homebuyer when searching on the Net, the number of locations on the screen where they fixate, and the time spent on each fixation point, which will serve as indicators of homebuyer preferences during the home search process. To our knowledge, there has never before been a study that has applied ocular tracking technology to examine psychological preferences in the area of real estate.

Specific Aims

a. Do homebuyers focus more on the photos, property statistics (square footage, number of bedroom/bathrooms, etc), or agent remarks when searching for homes on the Internet?

Each home tour begins by seeing these three components. Through the use of ocular tracking technology, we are able to measure to the millisecond exactly how long each person views each of these areas, where they focus and for how long. All of these ocular tracking metrics provide specific insight as to which are the most important parts of the Web page.

b. Is there a difference between stated and revealed preference?

This study is unique in real estate in that we do not ask participants what features they focus on when looking at the curb appeal of the house. We do not have to ask them to share their stated preference for home characteristics. We do not have to ask them on which features they fixated and for how long, thereby running the risk of biasing the data. Instead, we use ocular tracking software to measure and record their “revealed preferences or actions.” This, in and of itself, is a major contribution to the field of residential real estate brokerage.

c. How long will the buyer look before making a decision to learn more about the home or move on in their search?

We measure the exact time (dwell time and fixation time) it takes to fully assess or evaluate each home photo. Knowledge of this number will help listing agents decide exactly what types of pictures should be included on their Website and which one to lead with. Failure to grab the searcher’s attention within “x” number of seconds will result in the listing being passed by in favor of other listings. Marketers know this concept very well already. But, we are now able to attach a definitive number of seconds to what is currently only an educated guess.

d. How do negative characteristics associated with the home impact the overall perception of the home and the willingness to pay of the buyer?

We digitally alter a few select photographs throughout the home touring process to measure the impact of negative externalities in the mind of homebuyers. Specifically, we “painted” the walls of the main living area in two of the homes pink to measure the reaction of homebuyers. In a more severe controlled experiment, we used Photoshop to digitally superimpose ominous-

looking power lines outside the home that are apparent in the curb appeal photo. To our knowledge, no study has ever done this in any field.

e. Will any of these variables differ by gender, age, income, marital status, ethnicity, home buying experience, etc.?

Homebuyers come from a variety of backgrounds. Will any of the answers to the above questions change depending on the person taking the home tour? The literature is expectantly sparse in this area as past studies almost exclusively rely on the convenience sample of current students. We collect data on actual homebuyers and compare the results to data collected from students.

Literature Review

Eye movements are arguably the most frequent of all human movements. Large scanning movements called saccades typically occur 3-4 times every second; the search pattern followed by the eyes as they saccade from one point to another is called the scanpath; and, the amount of time spent at each point is the fixation time. Eye tracking as a methodology is based on Just and Carpenter's (1976) "eye-mind" hypothesis: the location of a person's gaze directly corresponds to the most immediate thought in a person's mind. In usability testing and advertising, eye tracking is useful because it can be used to measure behavior that would be difficult to obtain through other more overt measures (Karn, Ellis, and Juliano, 2000). Due to their close relation to attentional mechanisms, saccades can provide insight into cognitive processes such as picture comprehension, memory, mental imagery and decision-making. Thus, eye movement research

has historically been of great interest in the fields of neuroscience and psychiatry, as well as ergonomics, advertising and industrial design.

Eye tracking research that is most relevant to the purpose of our study has been found in the following areas: (1) reading print and online material, and (2) searching and scanning Web pages. Eye tracking studies of reading behaviors have yielded interesting and useful findings about how people visually interact with documents. Much of the usability-related research in this area centers on how variations in textual and graphical presentation affect behavior (Brysbart and Vitu, 1998). When readers encounter cognitively complex material, the rate at which they read slows considerably as shown by increases in eye fixation times and number of regressions (backtracking) and decreases in saccade lengths (Liversedge, Paterson, and Pickering, 1998). Furthermore, variations in type sizes affect the normal range of eye fixation durations, saccade movements, and regressions (Tinker, 1963). In studies of online reading, researchers have found that excessive use of color decreased reading speeds by as much as 30 to 40 percent (Krull and Rubens, 1987), although more recent studies have seen an increase in retrieval times – partially due to participants being more familiar with computers (Krull et al., 2004). As with reading, eye tracking research has provided insight into how people scan and search for information online. This has been done in using two methods – (1) in targeted-search studies, people are asked to identify specific information or perform a predefined task, and (2) in free-scan studies, by contrast, people are asked to view a screen or series of screens without any predefined goal.

In general, it has been found that people prefer text over graphics as entry points into Websites (Boaz et al., 2002). Also, eye movements roughly followed the "Z" pattern of design. People's eyes first travel to the upper left corner (typically where the Website identifying logo is placed), across the page to the right corner, and then continue scanning the page in small "z"

patterns progressing down the page (Goldberg et al., 2002). Interestingly, scanning did not end at the bottom right corner, but instead continued up the right column of the page.

In addition, small type encouraged focused reading behavior while large type promoted light scanning. When scanning, people are looking for words or phrases that catch their attention. Images of at least 210 X 230 pixels received more eye traffic than smaller images, and people frequently clicked on the 210 X 230 pixel images. Interestingly, scanpath analysis revealed that users do not necessarily follow the same scanpath for every type of Website; instead, there appear to be universal scanpaths that people develop based on the function, genre, and design of a Website (Josephson and Holmes, 2002).

Data and Design

To understand how homebuyers search for homes on the Internet, it is necessary to perform tests on actual homebuyers. To this end, we invited 20¹ currently searching or recent (within the last 3 months) homebuyers from the local area who are in the market for a home in the price range of \$285,000 - \$350,000². As a control group, we also perform our examination on 25 university students³. These 45 individuals were shown 10 homes each containing 6 photographs. The result is a cross-sectional dataset containing 450 (45 people x 10 homes) completed home tours and a total analysis of 2,700 (450 x 6) photos⁴. To our knowledge, this constitutes, by far, the largest sample collected in an ocular tracking study.

¹ We split the sample between 10 females and 10 males. Also, for married participants, only one member (husband or wife) was allowed to participate to avoid duplication of stated preferences.

² This research was supported by three local real estate brokerage firms who presidents serve on our real estate center's board. These firms kindly directed current clients to us for inclusion consideration.

³ The overwhelming majority of these types of studies examine only students because it is far easier to collect student data. We are also collecting student data simply to examine how results vary between this convenience sample and those from the population of homebuyers in whose behavior we are most interested.

⁴ All photographs used were from homes currently on the market in the local area. Original photographs were obtained directly from REIN, the company in charge of posting photos for the local MLS.

Participants were seated in front of a computer equipped with a 17 inch CRT monitor (optimal for ocular tracking due to its refresh rate). Below the monitor is a desk-mounted, unobtrusive ocular tracking hardware/software (Eyelink 1000) device⁵. When using the device, the participant positions his chin on a padded shelf with his forehead resting against a padded frame⁶. Once calibrated for that particular participant, a PC-based remote camera then records all eye movements. The task involves participants taking 10 different home tours on what effectively is the Internet⁷. Our Website intentionally reflects the appearance of those currently in existence. Specifically, there are three primary components of our opening page. The first is an enlarged curb appeal photograph which listing agents hope will catch the eye of the home searcher. Underneath this large photo are five thumbnail pictures of the remaining rooms in the home. The second section is located in the upper right-hand portion of the page and includes property statistics such as square footage, number of bedroom/bathrooms, and so forth. The third and final section of the opening page shares real estate agent “remarks” which is an opportunity for the agent to help sell the property through their use of language/opinion/marketing. Table 1 shares the layout of the Website.

(insert Table 1 here)

Once the opening page is viewed, the homebuyer can search the six component pictures of the house (curb appeal, main living area, kitchen, master bedroom, master bathroom, and

⁵ Participants must not be color-blind and must have normal or corrected-to-normal vision, since this is a primarily visual experiment with colored stimuli presented on the computer screen.

⁶ Other than these two somewhat parallel bars, nothing stands in the way between the participant and the monitor.

⁷ Technically, the tours take place on a self-contained, originally created program that allows us to completely control the process and avoid outside influences like pop-up advertisements and connectivity loss. The result is a seamless, uninterrupted home tour that allows us to track a myriad of ocular tracking-related variables of interest.

view/backyard). The participant is allowed an unlimited time to view each picture and may move forward in the search at any time simply by clicking a button. After the six photos of the first home are shown, the participant is asked a series of short questions which allow for the measurement of the user's ratings. This data was later used in a content analysis technique, described later in this study. Afterwards, the second home is shown, followed by a few questions about that home, and so forth. After five homes have been toured, the participant is allowed to take a short break and then continue to complete the second half of the tours. At the end of the visual portion of the experiment, the participant is asked to share basic demographic data (such as gender, age, marital status, ethnicity, income, etc.).

For validity of design, we alternate asking these general survey questions at the beginning versus the end of the visual portion of the experiment (to prevent such biases as cognitive anchoring). Other design mechanisms implemented to prevent respondent bias include randomizing the order of the 10 homes that are shown (to prevent order effects), as well as randomizing the order of the six pictures that are shown for each home. The one exception to this rule is that the curb appeal, or outside photo, is always shown first. This is done to be consistent with the way in which the overwhelming majority of Website tours begin. In short, we have made every attempt to minimize the potential for introducing bias, while at the same time keeping the search process as realistic as possible⁸. Because of the expensive equipment used and the need to avoid outside distractions, it was necessary to bring actual homebuyers onto campus and into our laboratory. For this reason, outside homebuyers were compensated with a \$50 gas card redeemable at a popular and nearby gas station⁹. Student participants were from Psychology classes and were given experiment participation credit, a practice very common in

⁸ The entire process takes between 35-45 minutes to complete.

⁹ The institution who supported this research via a large grant did not allow the distribution or handling of cash. The gas card was a way around the rule and thought to be nearly as good as cash.

the field.

Methodology

Since no study of this type has ever been conducted within a real estate setting, the analysis begins with a series of univariate tests and design verification procedures. Afterwards, a direct test of whether or not ocular tracking variables can be used to predict the willingness of a homebuyer to pay for a home is considered based on several variations of the following equation:

$$\text{Home Value} = f \{ \text{Home Characteristics, Qualitative Variables, Ocular Tracking Variables, Demographic Characteristics, Miscellaneous, Negative Externalities, error} \} \quad (1)$$

Where the specific variables are defined as follows:

Dependent Variables

% List Price	The participant's opinion of fair market value minus list price, divided by list price
Market Value Opinion	Participant's opinion of the fair market value of the home
Worth More Dummy	A dummy variable equal to 1 if the participant estimates the fair market value of the home to be greater than the listing price; 0 otherwise
Worth Less Dummy	A dummy variable equal to 1 if the participant estimates the fair market value of the home to be less than the listing price; 0 otherwise
Overall Home Rating	Participant's overall rating of the home on a scale from 1 (not at all favorable) to 9 (extremely favorable)

A. Home Characteristics

Actual Rating of the Rooms	Participant's ex-post rating of the specific room (photo) for the curb appeal, kitchen, main living area, master bedroom, master bathroom, and back yard/view on a scale from 1 (worst ever) to 9 (best ever)
Importance of the Rooms	Participant's ex-ante importance rating of the specific room (photo) for the curb appeal, kitchen, main living area, master bedroom, master bathroom, and back yard/view on a scale from 1 (not at all important) to 9 (very important)

B. Qualitative Variables

Total # of words	Total number of words the participant used to describe the home after the tour
# positive words	Number of positive words the participant used to describe the home after the tour
% positive words	Percentage of positive words (to total words) the participant used to describe the home after the tour
# negative words	Number of negative words the participant used to describe the home after the tour
% negative words	Percentage of negative words (to total words) the participant used to describe the home after the tour

C. Ocular Tracking Variables

Total Dwell Time	Total time spent looking at each picture (in milliseconds)
Fixation Duration	Average time spent at each fixation point within each picture (in seconds)
# of Fixations per picture	Number of points on the screen where the participant's eye stopped (i.e., fixated)
Saccade Count	The number of times the participant's eye jumped from one fixation point to the other
Saccade Amplitude	Average distance between fixation locations (computer screen distance)

D. Demographic Characteristics

Gender	Male = 0; Female = 1
Age	Age in years
Income	Annual income level (0 = \$0 - \$20,000; 1 = \$20,001 - \$40,000; 2 = \$40,001 - \$60,000; 3 = \$60,001 - \$80,000; 4 = \$80,001 - \$100,000; 5 = \$100,001 - \$120,000; 6 = Over \$120,000)
College Degree	1 = College degree; 0 = no college degree
Homeowner	1 = Has purchased a home before; 0 = otherwise
Homes Purchased	Number of homes purchased in lifetime
Married	1 = Married; 0 = Single
White	1 = White; 0 = non-White

E. Miscellaneous

Consumption Motive	1 = Consumption motive only; 0 = otherwise
Investment Motive	1 = Investment motive only; 0 = otherwise
% of Search on Web	Home search time spent on the Web (as a percentage of total home search time)
Familiarity with Market	Familiarity with the real estate market in the local area on a scale from 1 (not at all familiar) to 9 (extremely familiar)

F. Negative Externalities

Pink Walls 1 = The main living area has pink walls; 0 = otherwise
Power Lines 1 = Power lines are visible in the curb appeal photo of the home;
0 = otherwise

Dependent Variables

Agarwal (2007) and Seiler et al. (2010) document that people are not proficient at identifying the true value of the home in which they live. If this is the case, then asking them to accurately place a fair market value on a home they have only visited through a virtual home tour would seem more daunting. Still, in economics, finance and real estate, we are concerned with the willingness to pay for a home more so than just how a person rates the overall quality of the home. While we agree that a measure of a homebuyer's willingness to pay is a preferred measure to a simple rating of the home, we also recognize the difficulties in collecting this data through a controlled experiment. For this reason, we collect both measures and perform a series of regressions for both. Additionally, we further segment the analysis based on those who believe the home they toured is worth more (and less) than the listing priced offered by the selling agent via a series of logistic regressions.

A. Home Characteristics

Ex-ante homebuyer stated preferences are collected in terms of which rooms inside the house they believe to be the most important in the final assessment of whether or not they will like the home. These importance measures are then correlated with the ex-post ratings of how much the homebuyer liked the rooms as well as the overall home rating. Real estate agents often use the phrase "buyers are liars" to describe the frustration of showing clients exactly what they ask to see only to eventually have them buy a property whose attributes do not even remotely resemble

the original “must have” list. While it is not the central focus of our investigation to fully pursue this research question, we do take a cursory glance at the issue.

B. Qualitative Variables

Buying a home can be a very difficult and time consuming process. Not only is the purchase likely the largest an individual will ever make, but the selection of a home is one based on both rational economics and emotion. After completing the tour of each residence, we pause and ask participants to share the words that come to mind when thinking about the home they just toured. The list of forthcoming words may at times seem to represent a stream of unconsciousness. However, using textural data analysis techniques such as those in Price (2010), Dempsey et al. (2010) and (Li 2008), it is possible to classify these words as being positive, negative, or neutral. From this process, we are able to create and include in our quantitative analysis a number of variables that were previously too fuzzy (qualitative).

C. Ocular Tracking Variables

One of the key contributions of this study is to quantify variables that have previously been impossible to capture. Through the use of modern technology, we are able to record with incredible precision five key ocular tracking variables. The first is the total dwell time (in milliseconds) that each participant spends looking at each of the 2,700 photos in our sample. Past studies have shown that an increase in total dwell time is an indication of interest/ confusion/ concern (depending on the context of the experiment) by the viewer. Since our Web page is intentionally consistent across all home tours, we hypothesize dwell time to have a positive association with interest in the photo. A second captured measure is the number of fixation

points (referred to as fixation count) when viewing each of the photos. Fixation points represent locations where the viewer has slowed down to take a closer look at the photo. Fixation duration is the average time spent at each fixation point (typically in milliseconds). We similarly hypothesize a greater number of fixation points to be an indicator of either greater interest or more effort expended in viewing the image since evidence indicates that intense cognitive processing occurs during a fixation (Rayner, 1998).

Saccade count is the number of times the participant's eye jumped from one fixation point to the other. A related measure is saccade amplitude. This variable measures the average distance between fixation locations. Although there are several different interpretations of a saccade in the ocular tracking literature, it is generally accepted that when a saccade occurs, information is being suppressed (Rayner, 1998). Thus, the greater the number and length (amplitude) of saccades the less an individual was focusing on or actively interpreting the information in front of them; this could mean that greater saccade counts and longer saccade amplitudes imply: (1) a lower level of interest in the visual scene, or (2) a higher level of familiarity with the task/context and low need to search very thoroughly. Each of the five ocular tracking variables is collected for all 2,700 photos viewed in this study.

D. Demographic Characteristics

Because people of all demographic profiles search for homes on the Internet, it is not the focus on this study to examine the scanpath differences by demographic characteristics. Still, the data does allow for the inclusion of these as control variables. It is also of interest to see if the results change when moving from actual homebuyers to a convenience sample containing only students. As previously stated, the overwhelming majority of experiments are conducted on student

samples due to ease of access. The question is whether or not students provide a sufficient proxy or if it is necessary to go outside the university directly to the source (in this context, actual homebuyers).

E. Miscellaneous

Flachaire, Hollard, and Luchini (2003) used a novel approach to measure a variable they termed “conformist versus non-conformist” in a study of a participant’s willingness to pay for admission to a park. The process involves respondents answering a simple open-ended question, “When you think of (the park), what words come to mind?” Then, after a series of iterative steps similar to a factor analysis, a dummy variable is formed which allows for a quantification of a previously strictly qualitative concept. We adopt this approach to see if the manner in which a homebuyer views his home (as a consumption good versus an investment) influences his willingness to pay for the property.

The percentage of search time on the Web is also collected with the notion that more experienced Web searchers might view Web pages differently than those who are new to the process. For example, experienced searchers likely do not need nearly as much time to view an Internet real estate listing because they have seen so many already and presumably know what they are looking for. Our final independent variable is familiarity with the local residential real estate market. Increased familiarity should also influence the search process in a manner similar to experience on the Web.

F. Negative Externalities

An additional contribution of this study is that we consider the impact of two particular negative characteristics of a home. The first is an easily correctable paint selection in the main living area of the home. Specifically, using Photoshop software, we digitally painted pink walls in the main living area of two of the homes¹⁰. To allow for a *ceteris paribus* analysis, two different homes were painted pink and shown in exactly half of the home tours. Moreover, the homebuyers who were shown these homes were split 50/50 between men and women. In this way, we are able to collect an equally weighted sample of pink homes and compare them equally across their non-pink home counterparts spread evenly across gender. Since these pink walls can be repainted/corrected with \$20-\$40 worth of paint (and a total cost of roughly \$300 to include labor), we hypothesize that this negative home characteristic should not translate into a significant reduction in homebuyer willingness to pay.

A more severe (and non-correctable) negative property characteristic is the inclusion of ominous power lines located outside the home. Because these cannot be removed and because it is reasonable to expect homebuyers to want to avoid them, we hypothesize a significantly lower willingness to pay for these homes. In a similar fashion as the pink walls, Photoshop was used to superimpose the power lines in a visually convincing fashion¹¹.

Results

(insert Table 2 here)

¹⁰ Had pink been applied to the walls in a smaller bedroom, this would not have necessarily been a problem if the homebuyer has female children. For this reason, the pink was applied to a main living area within the home.

¹¹ To clarify the design, each participant toured a total of 10 homes. Of these 10 homes, one was pink, a different one had power lines, and eight were unchanged. However, since we wanted a *ceteris paribus* control group of the exact homes without pink walls (power lines), we had to adjust a third and fourth home photo. Therefore, when taken together, every person viewed just one of the two pink homes and only one of the two power lines homes. This involved the altering of four total photographs.

Panel A of Table 2 displays the total dwell times by the order in which the house was shown. Recall that the home order was semi-randomized to prevent order effects bias in the results. What is evident from the table is that the first home shown to participants took longer to view than the homes shown later in the experiment. A learning curve such as this completely expected with any new experience. So while the homebuyer has searched for homes on the Internet before, this is the first time they have seen our Website. The curve levels off almost immediately as dwell time to view homes in positions 2 through 10 are rarely significantly different from each other. In full anticipation of this observation, pink wall and power line houses are never shown in home positions 1 or 2. They can only be shown to the participant on houses 3 and later. Again, this was done to prevent the learning curve from contaminating our negative externality (i.e., pink walls and power lines) examination results.

Panel B considers the order effects of rooms within the home. Recall that the curb appeal photo was always shown first to the participant as this is the common industry practice. Photos two through six randomly shuffle through the remaining rooms of the house which is also consistent with both cyber space tours and physical tours of a home. ANOVA and Post Hoc tests reveal very few significant differences in dwell times for any of the rooms. This suggests that participants maintained a fairly consistent speed while scrolling through the Website.

(insert Table 3 here)

Summary statistics for the dependent variables in Equation (1) are listed in Panel A of Table 3. As expected, both homebuyers and students estimate the true market value of the home to be less than the list price. This is consistent with both observational intuition and cognitive anchoring

hypotheses. Both groups estimate prices to be over-stated by roughly 5% - 6%. Interestingly, homebuyers report a higher market price for the homes, but a lower overall rating when compared to students. This conflicting result is often argued to exist in studies that are published in marketing versus real estate/finance journals and was the impetus for collecting both metrics in this investigation. There are no statistically significant differences in Panel A, however.

Panel B displays the ex-post or actual ratings for each photo of the house followed by the ex-ante stated level of importance when evaluating a residence. While four of the six importance ratings are statistically significantly different between the two groups of sample participants, only one (a different room) was significant in terms of ex-post evaluation. After the home was toured, participants were asked what words come to mind when thinking of the home just toured. Using content analysis (Berelson, 1952), these terms were coded based on three concepts: positivity, negativity, and neutrality. Based on the survey questions given to each participant in the beginning (or ending – for the other half of the sample) of the study, each word was then further coded based on a relational analysis, meaning that we coded for the underlining concept of each word cross-referenced with the participant's verbal description of each property immediately after it was viewed. Coding participant data in this manner is a typical method for trying to understand the mental models participants construct (Flachaire, Hollard, and Luchini (2003; Carley and Palmquest, 1992). While homebuyers use significantly more words to describe the home, students and homebuyers are remarkably similar in both their number and percentage of positive and negative words.

Significant differences between homebuyers and students only begin to emerge when considering the ocular tracking variables presented in Panel D. Specifically, homebuyers take significantly less time to view each room in the house when compared to students. This result is

fully anticipated given that homebuyers have already been searching for homes and therefore better know what they are looking for when perusing a Website. A similar pattern of significant differences between homebuyers and students is seen in the number of fixations per picture and saccade count. Consistent with our expectations, experienced homebuyers fixated less and demonstrated fewer saccades indicating that experience and familiarity with the context compensated for the need to search thoroughly. However, this could also be an indication of low interest in the Website display (Rayner, 1998), which poses an additional challenge when designing for the experienced buyer. Without the use of ocular tracking technology, these challenges would never be known.

Understandably, the demographic profile of a typical student differs greatly from that of a typical homebuyer. For example, homebuyers in our sample are significantly older, earn more income, have a higher level of education, have owned more homes in the past, and are more likely to be married. Simply put, they are further along in life. Homebuyers have a significantly greater percentage of search time on the Web and a greater familiarity with the local residential real estate market. Finally, homebuyers are more likely to consider the investment component of a home when making a purchase. In fact, not one of the 25 students associated strictly investment related words when buying a home compared to 16% of homebuyers. Similarly, the consumption only motive was mentioned in 80% of student cases as opposed to just 62% of homebuyers. Clearly, a homebuyer is thinking more in terms of both consumption and investment when searching for a home.

In sum, while the demographic profile between homebuyers and students are significantly different across almost every measure, and while the groups do not seem to agree on what they

are looking for in a home (ex-ante), the ex-post results reported thus far are strikingly similar with the exception of three of the five ocular tracking variables.

(insert Table 4 here)

Table 4 is similar in design to the previous table except now only homes relating to power lines are considered. Recall that each of the 45 participants was shown only one of two homes that were digitally altered to introduce a curb appeal photo with clearly visible power lines. As a control sample, the exact same homes without power lines were shown as well. The result is an even divide of 45 power line homes and their otherwise equivalent 45 non-power line counterparts. This design allows for a ceteris paribus evaluation of the effect of power lines on perceived home values. In both the overall and student samples, significantly fewer people thought the home was worth more than the list price once power lines were introduced. Moreover, students significantly valued power line homes less than list price. Not surprisingly, homes without power lines are associated with a greater percentage of positive words. When it comes to the explicit mention of power lines, homebuyers are significantly more likely to mention it (when asked what words come to mind when thinking of the home just toured) to the controller of the experiment (60% versus just 24% of the time for students). However, this should not be interpreted as students not noticing. Not only would it be hard to imagine the power lines not being noticed, but students also value the homes lower than homebuyers (\$295,478 versus \$300,461). In a direct comparison, homebuyers penalize a home with power

lines in the amount of roughly \$13,500, whereas students view power line homes to be worth nearly \$9,500 less¹².

Panel E is new to the analysis in that instead of calculating the ocular tracking variables across an entire photograph, various “interest areas (IA),” or sections of interest within each photograph, are examined instead. Specifically, area one includes the photo of the home. IA two focuses on just the property characteristics (square footage, school district, number of bedrooms and bathrooms, etc.) of the home, while IA three includes the real estate agent remarks. While the results are not significantly different between power line and non-power line samples (as indicated by an absence of asterisks), there are significant differences between the dwell times and number of fixation points between homebuyers and students (as indicated by the bold numbers). Homebuyers spend significantly less time looking at the curb appeal photo (which has the power lines in it), and significantly more time reviewing the property statistics and agent remarks. A similar pattern emerges when discussing the number of fixation points. In sum, homebuyers spend less time looking at the photo, but report the power lines more often and penalize the power line house more severely than students. These findings seem to indicate that homebuyers know better what they are looking for in a home, can find it quicker, and are more interested in the details that cannot be gleaned from a photo. These findings on IAs lend further support to the earlier data on saccade counts and amplitudes, which revealed an obvious lack of interest (or focus) of homebuyers on the Webpage itself. The IA analyses clearly suggests that saccade counts and amplitudes were shorter possibly because experienced homebuyers were able to narrow down very quickly to the specific part of the Webpage that was of interest and value to them. We suspect homebuyers read more about the house because they are actually in the market

¹² Because of the somewhat small sample size, this seemingly economically significant difference is not statistically significant.

for buying these houses (which they were accurately told are currently on the market), whereas for students, the experiment is more of an exercise as opposed to a process necessary to accomplish the ultimate goal of buying a home.

(insert Table 5 here)

Table 5 reports results from tests that are similar in design to Table 4 except now homes with pink walls are considered. Homebuyers penalize the pink walled homes to the tune of \$4,500, an amount that while statistically non-significant, seems a bit high. Conversely, students valued these homes higher (by \$1,800) than their non-pink counterparts, although again not significantly so. As before, homebuyers are significantly more likely to mention the word “pink” when thinking of the home just shown to them. Given that pink walls should not be a legitimate deterrent to buying a home, it is not surprising that ocular tracking variables do not differ significantly across sub-samples or between pink and non-pink photos.

(insert Table 6)

Panel A of Table 6 correlates dwell time with the ex-ante stated preference of what is important to sample participants. Correlation coefficients are either insignificantly different from zero or significantly negative. The interpretation is that a person does not have to look at a photo for a long time to gather from it the information necessary to reach a conclusion. In fact, the opposite is true. People seem to be more efficient at gathering information when the photo is of greater importance. Panel B of the table relates the ex-post evaluations of the overall home rating to the

individual rating of each room. While all rooms are significantly positively correlated with the overall rating, no room in particular stands out as being more as an indicator of the overall evaluation of the home. Finally, Panel C correlates the five ocular tracking variables to decide which ones should not be included in the estimation of Equation (1) due to multicollinearity concerns.

(insert Table 7 here)

Table 7 reports the results from six different variations of estimates to Equation (1)¹³. In the first three regressions, the dependent variable is the participant's estimate of the home's value as a percentage of the list price. Recall that price is a measure more palatable to real estate economists. The fourth through sixth regressions have the overall home rating on a scale from 1 to 9 as the dependent variable – a measure used more in psychology and marketing studies. Unreported correlations indicate that multicollinearity concerns prevent the inclusion of all the demographic variables. Therefore, in the first regression, a dummy variable for participant type will be used to capture differences that exist between homebuyers and students. Consistent with the results in Table 3, homebuyers and students are heterogeneous between groups, but extremely homogeneous within each group. As such, only low correlated variables are included in each subsequent regression.

As hypothesized, the percentage of negative words is significantly negative in all three regressions¹⁴. Total dwell time and fixation duration is significantly positive and driven primarily

¹³ Because each participant views 10 homes, we include in all regressions nine (n-1) "home number" dummy variables to control for fixed effects.

¹⁴ When the percentage of positive words is included instead, the result is a consistently positive and significant coefficient. As such, either variable (but not both due to their significant negative correlation) can be used in the

by the student sample, while the statistically negative coefficient on saccade amplitude is driven primarily by the homebuyer sample. Homebuyers with a higher income perceive prices to be significantly lower than lower income buyers, presumably because they are in the market for higher priced (and therefore, nicer) homes. The same relationship is true for experienced homebuyers. They appear not to be as easily impressed as less seasoned buyers. Consistent with univariate tests, the negative coefficient on the participant type dummy variable indicates that students perceive the value of homes within the sample to be lower than the perception of value by homebuyers.

When comparing the results from the percentage of list price regressions to the results from the overall home rating regressions, the dependent variable does seem to make a difference. The sign changes for three of the variables (total dwell time, consumption motive, and participant type). In two of the cases, the variable becomes insignificant, but in the case of the consumption motive, the sign changes direction and significance. While it is not possible to know which dependent variable is a better choice on which to base the analysis, it is simply our purpose to identify the fact that the two measures, at times, yield significantly different results. This is a topic we suggest future studies delve into further.

(insert Table 8 here)

Table 8 reports six separate logistic regression results from two variations of Equation (1). Otherwise similar to the specifications in the prior table, the new dependent variable for the first three columns is a dichotomous variable, set equal to one if the participant believes the home is worth *more* than the list price and zero otherwise. In the last three logistic regressions, the

regressions.

dependent variable is set equal to one if the participant believes the home is worth *less* than the list price. For the full sample logistic regression in the first column, as expected, the percentage of positive words carries a significantly positive coefficient as does total dwell time and fixation duration. Also as expected, power lines are significantly negatively related to thinking the home is worth more than the list price, while having pink walls is not significant. These results are clearly driven by the student portion of the sample where the signs and significance levels are consistent. Alternatively, for the homebuyer sub-sample, only the numbers of homes purchased in the past is significant.

In the three logistic regressions attempting to model the causes of participants who believe a home is worth less than its list price, the percentage of negative words used to describe the house replaces the percentage of positive words. Consistent with expectations, the coefficient is positive and significant. The signs for fixation duration and saccade amplitude have switched when moving from the worth *more* to worth *less* regressions, as expected. Fixation duration not only switched signs, but also retained its statistical significance. We interpret this to mean that when a person likes the home, they will fixate for greater periods of time. But, when they do not like the home, they will experience shorter fixation periods. In both of the full sample logistic regressions, the variable participant type is not significant.

Conclusions

This study is the first to use ocular tracking technology in a real estate setting. En route to learning more about how people search for homes on the Internet, we also examine the impact of negative externalities on home prices. Specifically, we examine the impact of having pink walls in the main living area of the home and separately the impact of having power lines running near

the home. Consistent with rational expectations, we find an insignificant price differential associated with showing a home with pink walls (1.03%, or \$3,002), but a substantial discount when showing a home with nearby power lines (-3.64%, or -\$11,240).

This study also compared the results of actual homebuyers versus the convenience sample of student participants. While the demographic differences are in stark contrasts, the results typically are not. However, significant differences are observed in a number of the ocular tracking variables used in this study: total dwell time, number of fixations, and saccade count.

Since this is the first study of its kind, we focused on fundamental concepts and an exploratory understanding of how people search for homes on the Net. Future studies should extend the work described here by testing the impact on various Website designs. By performing a similar analysis to ours, after altering the layout of the page, real estate agents can begin to learn which designs best grab the homebuyer's attention. Moreover, in future studies, it would be beneficial to simply observe homebuyers in their natural element where they are free to continuously surf the Internet for homes without having to pause periodically and answer questions about what they have just seen. Still, the first steps taken in the current investigation are necessary groundwork that needs to be laid before these more advanced investigations can be considered.

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Table 1. Sample View of the Website Design with a Typical Ocular Tracking Variable Analysis Superimposed

This table shows the first page the participant sees when they begin the tour of a home. Additionally, this picture also includes an indication of the 6 "Interest Areas" as well as various Ocular Tracking measured superimposed on top.

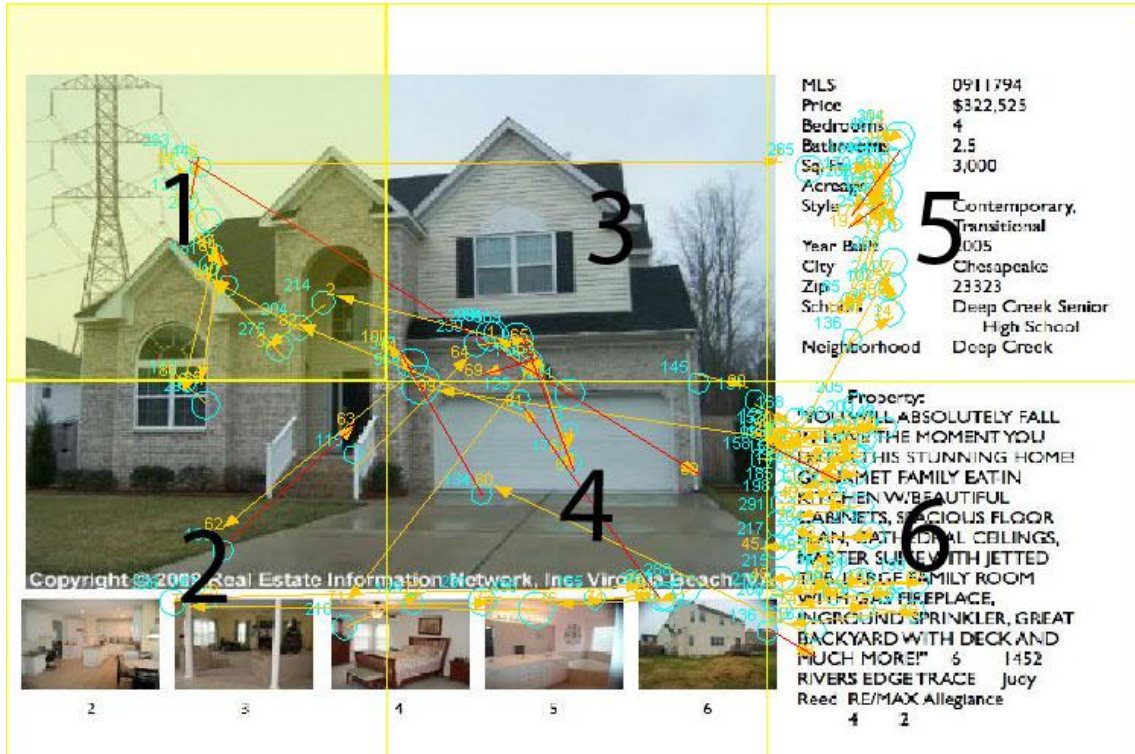


Table 2. Total Dwell Time versus Order in Which House and Room Were Shown

Panel A of this table shows the dwell times for the homes that appear in the first through tenth positions. Panel B displays total dwell times the order in which the room was shown. The curb appeal photo was always shown first. The home order and all other rooms were randomized in order to avoid biasing the results.

	Overall	Curb Appeal	Kitchen	Main Living Area	Master Bedroom	Master Bathroom	Backyard/View
Panel A: Total Dwell Time by house							
Home Pos 1	64,590***	21,653	8,677	9,801**	9,701***	8,996**	9,483**
Home Pos 2	56,963	20,311	6,872	8,086	7,454*	7,812	7,208**
Home Pos 3	57,909*	22,012	8,794	9,073**	8,984***	8,245	8,274
Home Pos 4	55,982	19,203	8,402	7,508	8,449***	7,238*	9,223*
Home Pos 5	56,231	19,757	7,418	8,692	8,001	8,576	8,127
Home Pos 6	55,369	20,234	7,451	7,709	7,706	7,676	6,974**
Home Pos 7	56,886	20,401	8,797	7,210*	7,532	7,955	8,635
Home Pos 8	50,437*	17,701	7,517	8,062	6,672***	7,964	8,169
Home Pos 9	54,700	18,762	7,179	7,483	6,704***	6,926**	8,804
Home Pos 10	55,827	20,445	8,075	6,977**	6,891***	7,653	7,394*
ANOVA	1.30	0.42	1.35	1.44	2.32**	0.68	1.10
F-statistic	(.232)	(.924)	(.208)	(.169)	(.015)	(.727)	(.360)
Panel B: Total Dwell Time by Order Room was Shown							
Rm. Order 1		20,052					
Rm. Order 2			8,103	9,639*	7,650	9,680	9,300
Rm. Order 3			8,692*	7,551	7,784	7,877	8,193
Rm. Order 4			8,171	7,425*	8,176	7,697	8,849
Rm. Order 5			7,118*	7,374	7,425	7,401	8,280
Rm. Order 6			7,221	8,284	7,884	7,192	7,069
ANOVA			1.93	0.83	0.78	0.48	0.35
F-statistic			(.104)	(.509)	(.537)	(.753)	(.845)

1. Overall column significance levels are based on ANOVA Tests.
2. Significance indicators within specific cells are based on Post Hoc tests. Specific tests were selected after a Levene statistic was computed in order to make the correct assumption regarding homogeneity of variance.

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

Table 3. Descriptive Statistics by Sample Participants

This table displays minimum, maximum, and mean values for the three categories of participants: full sample, homebuyers, and students.

	Full Sample			Homebuyers			Students		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
Panel A: Dependent Variable									
% List Price	-0.54	0.83	-5.07%	-0.42	0.83	-4.22%	-0.54	0.25	-5.75%
Market Value Opinion	150,000	550,000	301,164	185,000	550,000	303,776	150,000	400,000	299,074
Worth More Dummy	0	1	.20	0	1	.16	0	1	.22
Worth Less Dummy	0	1	.56	0	1	.58	0	1	.55
Overall Home Rating	1	9	6.52	1	9	6.45	3	9	6.57
Panel B: Home Characteristics									
<i>Actual Rating</i>									
Curb Appeal	1	9	6.46	1	9	6.40	2	9	6.50
Kitchen	1	9	6.26	2	9	6.14	1	9	6.36
Living Room	1	9	6.13*	1	9	5.97	2	9	6.26
M. Bedroom	1	9	5.95	2	9	5.97	2	9	5.94
M. Bathroom	1	9	6.16	2	9	6.19	2	9	6.14
Backyard/View	1	9	6.19	1	9	6.26	1	9	6.13
<i>Importance</i>									
Curb Appeal	2	9	6.78*	2	9	7.35	3	9	6.32
Kitchen	3	9	7.79**	3	9	7.62	6	9	7.92
Living Room	4	9	7.69	5	9	7.65	4	9	7.72
M. Bedroom	4	9	7.60**	4	9	7.45	5	9	7.72
M. Bathroom	3	9	7.29	4	9	7.35	3	9	7.24
Backyard/View	2	9	7.24**	2	9	7.05	4	9	7.40
Panel C: Qualitative Variables									
Total # of words	1	8	3.24**	1	8	3.39	1	7	3.12
# positive words	0	7	1.56	0	7	1.61	0	6	1.53
% positive words	0	1	48.07	0	1	45.53	0	1	50.10
# negative words	0	5	0.93	0	4	0.88	0	5	0.97
% negative words	0	1	30.89	0	1	28.26	0	1	32.99
Panel D: Ocular Tracking Variables									
<i>Total Dwell Time</i>									
Overall	6,082	168,749	56,488	27,720	168,749	57,164	6,082	141,379	55,945
Curb Appeal	5,658	94,300	20,052**	5,658	45,200	18,533	5,907	94,300	21,266
Kitchen	2,898	33,131	7,917***	2,929	18,152	7,229	2,898	33,131	8,458
Living Room	1,685	45,098	8,058***	1,685	34,942	7,362	2,728	45,098	8,612
M. Bedroom	1,361	42,189	7,817***	2,451	28,323	6,891	1,361	42,189	8,550
M. Bathroom	2,963	42,535	7,902***	2,963	34,569	6,861	3,240	42,535	8,733
Backyard/View	2,788	65,715	8,228***	2,981	33,411	7,443	2,788	65,715	8,845

<i>Fixation Duration</i>									
Overall	109	729	263.76	109	436	259.67	112	729	267.02
Curb Appeal	49	489	253.40	49	439	249.66	90	489	256.39
Kitchen	48	566	253.07	48	503	252.76	70	566	253.32
Living Room	51	553	259.93	72	553	259.11	51	485	260.58
M. Bedroom	61	582	251.57	61	582	250.42	62	474	252.48
M. Bathroom	39	778	251.80	56	778	251.89	39	433	251.73
Backyard/View	60	533	253.53	63	533	253.82	60	502	253.30
<i># of Fixations per picture</i>									
Overall	14	514	156.59***	18	514	166.22	14	349	148.89
Curb Appeal	3	265	60.74	3	161	59.05	16	265	62.10
Kitchen	4	111	24.40**	4	64	22.83	6	111	25.64
Living Room	5	117	24.39*	7	104	22.91	5	117	25.56
M. Bedroom	2	119	24.05**	2	119	22.15	3	117	25.56
M. Bathroom	3	113	24.53***	3	113	21.73	4	111	26.76
Backyard/View	3	163	24.77*	3	113	23.22	5	163	25.99
<i>Saccade Count</i>									
Overall	2	513	154.55**	2	513	163.29	14	349	147.55
Curb Appeal	2	264	60.10	2	161	58.21	15	264	61.61
Kitchen	3	111	24.31**	3	64	22.65	6	111	25.61
Living Room	2	116	24.16**	2	104	22.49	4	116	25.49
M. Bedroom	2	120	23.94***	3	120	21.98	2	117	58.48
M. Bathroom	3	113	24.40***	3	113	21.54	4	111	26.66
Backyard/View	2	163	24.67*	2	113	23.06	5	163	25.94
<i>Saccade Amplitude</i>									
Overall	2	11	3.13***	2	11	3.37	2	5	2.94
Curb Appeal	1	11	2.78	1	11	2.75	1	6	2.80
Kitchen	1	11	2.98	1	11	2.98	2	7	2.97
Living Room	1	13	2.95	1	13	3.02	1	6	2.90
M. Bedroom	1	10	3.11	1	10	3.05	2	7	3.16
M. Bathroom	1	15	3.09	1	15	3.13	2	6	3.05
Backyard/View	2	21	2.93	1	21	2.98	1	6	2.90
Panel E: Demographic Variables									
Males	0	1	40%***	0	1	50%	0	1	32%
Age	18	54	29.60***	22	54	37.35	18	43	23.40
Income	0	6	1.69***	0	6	2.85	0	5	0.76
College Degree	0	1	36%***	0	1	75%	0	1	4%
Homeowner Dummy	0	1	53%***	0	1	90%	0	1	24%
Homes Purchased	0	8	1.24***	0	8	2.40	0	2	0.32
White Dummy	0	1	73%***	0	1	85%	0	1	64%
Married Dummy	0	1	36%***	0	1	55%	0	1	20%
Panel F: Miscellaneous Variables									
Consumption Motive	0	1	62%***	0	1	40%	0	1	80%
Investment Motive	0	1	16%***	0	1	35%	0	1	0%
% of Search on Web	0	100	59%***	2	100	71%	0	100	48%
Familiarity w/ Market	1	9	4.22***	1	9	5.10	1	7	3.52

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

2. Significance is based on Independent Samples T-Tests. Specific tests were selected after a Levene statistic was computed in order to make the correct assumption regarding homogeneity of variance.

Table 4. Descriptive Statistics Associated with the Power Lines by Sample Participants

This table displays mean values for the three categories of participants: full sample, homebuyers, and students only for the power line photographs.

	Full Sample		Homebuyers		Students	
	Power Line	No Power Line	Power Line	No Power Line	Power Line	No Power Line
Sample Size	N = 45	N = 45	N = 20	N = 20	N = 25	N = 25
Panel A: Dependent Variable						
% List Price	-8.02%	-4.52%	-7.16%	-3.02%	-8.72%	-5.72%
Market Value Opinion	297,693	308,933	300,461	313,848	295,478	305,002
Worth More Dummy	13.33%**	31.11%**	20.0%	25.0%	8.0%**	36.0%**
Worth Less Dummy	73.33%	60.00%	65.0%	65.0%	80.0%*	56.0%*
Overall Home Rating	6.18	6.49	5.95	6.35	6.36	6.60
Panel B: Home Characteristics						
Curb Appeal Rating	6.67	7.09	6.40	7.10	6.88	7.08
Panel C: Qualitative Variables						
Total # of words	3.33	3.16	3.65	3.20	3.08	3.12
# positive words	1.47	1.69	1.45	1.80	1.48	1.60
% positive words	45.63%*	57.93%*	39.08%*	61.17%*	50.87%	55.33%
# negative words	1.13	0.84	1.05	0.90	1.20	0.80
% negative words	33.85%	26.15%	29.83%	25.75%	37.07%	26.47%
Mention Power Lines?	40.0%	--	60.0%	--	24.0%	--
Panel D: Ocular Tracking Variables						
Total Dwell Time	18,357	19,446	18,377	18,487	18,341	20,214
Fixation Duration	251.50	242.38	250.21	232.00	252.53	250.68
# of Fixations per picture	57.62	57.98	60.15	57.90	55.60	58.04
Saccade Count	56.49	58.07	58.54	58.80	54.84	57.48
Saccade Amplitude	2.85	3.06	2.81	2.96	2.89	3.15
Panel E: Interest Area Details						
<i>Total Dwell Time</i>						
Photographs	8,850	7,319	7,530	6,491	10,107	8,108
Property Summary Stats	2,597	2,760	3,558	3,148	1,682	2,391
Agent Remarks	2,645	2,400	3,877	3,625	1,472	1,234
<i>Number of Fixations</i>						
Photographs	34.56	30.61	30.75	28.45	38.19	32.67
Property Summary Stats	9.05	9.93	12.30	11.75	5.95	8.19
Agent Remarks	11.63	10.05	16.30	14.35	7.19	5.95

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

2. Significance is based on Independent Samples T-Tests. Specific tests were selected after a Levene statistic was computed in order to make the correct assumption regarding homogeneity of variance.

3. Bold indicates significance at a minimum level of 90% based on Independent Samples T-Tests.

Table 5. Descriptive Statistics Associated with the Pink Walls in the Main Living Area by Sample Participants

This table displays mean values for the three categories of participants: full sample, homebuyers, and students only for the pink wall photographs.

	Full Sample		Homebuyers		Students	
	Pink Walls	No Pink Walls	Pink Walls	No Pink Walls	Pink Walls	No Pink Walls
Sample Size	N = 45	N = 45	N = 20	N = 20	N = 25	N = 25
Panel A: Dependent Variable						
% List Price	-3.61%	-4.17%	-5.28%	-6.92%	-2.26%	-1.97%
Market Value Opinion	292,511	289,509	286,150	281,645	297,600	295,800
Worth More Dummy	24.4%	15.56%	10.0%	15.0%	36.0%	16.0%
Worth Less Dummy	53.3%	48.89%	60.0%	70.0%	48.0%	32.0%
Overall Home Rating	6.24	6.31	5.95	6.25	6.48	6.36
Panel B: Home Characteristics						
Living Room Rating	4.67	5.98	4.20	6.10	5.04	5.88
Panel C: Qualitative Variables						
Total # of words	3.18	3.33	3.35	3.35	3.04	3.32
# positive words	1.13	1.33	0.95	1.30	1.28	1.36
% positive words	36.93%	40.04%	28.92%	36.25%	43.33%	43.07%
# negative words	1.02	1.29	0.95	1.40	1.08	1.20
% negative words	31.78%	41.15%	28.25%*	45.92%*	34.60%	37.33%
Mention Pink Walls?	33.3%	--	60.0%	--	12.0%	--
Panel D: Ocular Tracking Variables						
Total Dwell Time	9,028	7,542	8,351	7,496	9,570	7,578
Fixation Duration	255.22	266.03	261.56	264.84	250.15	266.98
# of Fixations per picture	26.78	22.67	25.10	24.10	28.12	21.52
Saccade Count	26.67	22.56	24.90	23.95	28.08	21.44
Saccade Amplitude	3.19	3.05	3.36	2.95	3.05	3.12
Panel E: Interest Area Details						
<i>Total Dwell Time</i>						
Photographs	6,122	5,519	6,292	5,383	5,961	5,649
Property Summary Stats	147.15*	343.71*	85.00**	515.55**	206.33	180.05
Agent Remarks	21.05	110.68	10.25	214.10	31.33	11.90
<i>Number of Fixations</i>						
Photographs	24.07	20.93	24.55	21.10	23.62	20.76
Property Summary Stats	0.63	1.39	0.40**	2.00**	0.86	0.81
Agent Remarks	0.10	0.54	0.05	1.00	0.14	0.10

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

2. Significance is based on Independent Samples T-Tests. Specific tests were selected after a Levene statistic was computed in order to make the correct assumption regarding homogeneity of variance.

3. Bold indicates significance at a minimum level of 90% based on Independent Samples T-Tests.

Table 6. Selective Correlations Coefficients by Sample Participants

This table displays correlation coefficients between selected potential independent variables for the three categories of participants: full sample, homebuyers, and students.

Panel A: Importance and Dwell Time						
	Full Sample (N = 450)	Homebuyers (N = 200)	Students (N = 250)			
Curb Appeal	.000	-.040	.074			
Without Power Lines ¹	-.004	-.046	.073			
Kitchen	-.085*	-.154**	-.076			
Living Room	-.027	-.139**	.030			
Without Pink Walls ¹	-.036	-.140**	.021			
M. Bedroom	-.197***	-.282***	-.188***			
M. Bathroom	-.148***	-.231***	-.104			
Backyard/View	-.147***	-.218***	-.135**			
Panel B: Overall and Room Ratings						
	Curb Appeal	Kitchen	Living Room	M. Bedroom	M. Bathroom	Backyard/View
Kitchen	.401***					
Living Room	.408***	.595***				
M. Bedroom	.484***	.525***	.631***			
M. Bathroom	.493***	.490***	.547***	.611***		
Backyard/View	.295***	.369***	.440***	.450***	.384***	
Overall	.512***	.513***	.535***	.537***	.490***	.509***
Panel C: Ocular Tracking Variables: Curb Appeal²						
	Total Dwell Time	Fixation Duration	# of Fixations	Saccade Count		
Fixation Duration	.216***					
# of Fixations	.929***	.067				
Saccade Count	.922***	.059	.996***			
Saccade Amplitude	-.144***	-.218***	-.196***	-.191***		

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

1. Removing Power Line or Pink Wall photos results in a sample size for the full sample, homebuyers, and Students of 405, 180, and 225, respectively.
2. Correlation coefficients are qualitatively similar no matter which room is considered.

Table 7. Regression Results by Sample Participants

This table reports the regression results from 6 separate regressions based on Equation 1 after removing independent variables that are too highly correlated. The dependent variable is the participant’s opinion of value as a percentage of list price. Independent variables include the percentage of words used to describe the home which are negative; total dwell time; fixation duration; saccade amplitude; a dummy variable for homes with pink walls where 1 = the walls are pink, and 0 otherwise; a dummy variable for homes near power lines where 1 = homes near power lines, and 0 otherwise; participant income; total homes purchased in lifetime; a dummy variable for the consumption motive where 1 = participants who expressed words for home ownership that only relate to the consumption component of owning a home, and 0 otherwise; and participant type where 0 = homebuyers, and 1 = students.

	Percentage of List Price			Overall Home Rating		
	Full	Homebuyers	Students	Full	Homebuyers	Students
% Negative Words	-.094*** (.017)	-.102*** (.025)	-.079*** (.022)	-1.549*** (.165)	-1.894*** (.252)	-1.232***
Total Dwell Time	5.98 ⁻⁷ ** (.000)	2.75 ⁻⁷ (.000)	1.02 ⁻⁶ *** (.000)	-4.14 ⁻⁶ (.000)	-9.34 ⁻⁹ *** (.000)	-1.74 ⁻⁸ (.000)
Fixation Duration	.000** (.000)	.000 (.000)	.000*** (.000)	.001 (.001)	.000 (.002)	.001 (.001)
Saccade Amplitude	-.011* (.006)	-.015** (.007)	-.019 (.013)	-.007 (.058)	-.056 (.069)	-.005 (.128)
Pink Walls	-.007 (.024)	-.002 (.035)	-.014 (.032)	-.212 (.240)	-.599* (.342)	.047 (.315)
Power Lines	-.028 (.025)	-.040 (.035)	-.015 (.033)	-.119 (.244)	-.189 (.351)	-.059 (.319)
Income		-.009* (.005)			-.018 (.046)	
Homes Purchased		-.015*** (.004)			-.184*** (.044)	
Consumption Motive		.014 (.018)			-.311* (.182)	
Participant Type	-.017*** (.017)			.164 (.112)		
Sample Size	450	200	250	450	200	250
F-Statistic	9.324***	5.484***	7.427***	11.687***	8.407***	6.643***
Adjusted R-Squared	.231	.293	.280	.278	.406	.254
Maximum VIF	2.320	2.350	2.350	2.320	2.350	2.350

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

1. The nine (n-1) “house number” fixed effects variables are suppressed for the sake of brevity, but are available from the authors upon request.

Table 8. Logistic Regression Analysis for the Dichotomous Dependent Variables Indicating Whether the Home is Worth More or Less than the List Price

This table reports the regression results from 6 separate regressions based on Equation 1 after removing independent variables that are too highly correlated. The dependent variable in the first three regressions is a dummy variable where 1 = the participant's opinion of value is greater than the list price, 0 otherwise. The dependent variable in the last three regressions is a dummy variable where 1 = the participant's opinion of value is less than the list price, 0 otherwise. Independent variables include the percentage of words used to describe the home which are positive; percentage of words used to describe the home which are negative; total dwell time; fixation duration; saccade amplitude; a dummy variable for homes with pink walls where 1 = the walls are pink, and 0 otherwise; a dummy variable for homes near power lines where 1 = homes near power lines, and 0 otherwise; participant income; total homes purchased in lifetime; a dummy variable for the consumption motive where 1 = participants who expressed words for home ownership that only relate to the consumption component of owning a home, and 0 otherwise; and participant type where 0 = homebuyers, and 1 = students.

	Worth More Dummy			Worth Less Dummy		
	Full	Homebuyers	Students	Full	Homebuyers	Students
% Positive Words	1.238*** (.414)	-.032 (.682)	2.519*** (.634)			
% Negative Words				1.589*** (.358)	2.141*** (.645)	1.289*** (.477)
Total Dwell Time	.000* (.000)	.000 (.000)	.006** (.002)	.000 (.000)	.000 (.000)	.000 (.000)
Fixation Duration	.005*** (.002)	.002 (.004)	.000*** (.000)	-.006*** (.002)	.001 (.004)	-.008*** (.002)
Saccade Amplitude	-.197 (.156)	-.235 (.205)	-.147 (.356)	.062 (.117)	.152 (.161)	-.250 (.281)
Pink Walls	.505 (.564)	-.423 (1.008)	.978 (.789)	.402 (.453)	-.052 (.762)	.866 (.643)
Power Lines	-1.21* (.690)	-.991 (1.145)	-2.116** (1.062)	.478 (.594)	-.049 (.940)	.999 (.872)
Income		.042 (.137)			.008 (.106)	
Homes Purchased		-.296* (.167)			.459*** (.122)	
Consumption Motive		.851 (.543)			-.927** (.435)	
Participant Type	.288 (.281)			-.179 (.225)		
Sample Size	450	200	250	450	200	250
Overall Model Chi-Square	93.65***	38.47***	85.513***	109.11***	71.42***	78.77***

-2 Log Likelihood	351.71	139.22	179.94	501.46	195.68	264.29
Cox and Snell R-Square	.190	.178	.291	.217	.305	.271
Nagelkerke R-Square	.300	.299	.443	.291	.410	.363
% Correctly Classified	82.7%	83.7%	83.5%	70.1%	76.5%	76.3%

*** Significance at 1%; ** Significance at 5%; * Significance at 10%

1. The nine (n-1) "house number" fixed effects variables are suppressed for the sake of brevity, but are available from the authors upon request.