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Title: Reference Dependence in the UK property market

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Reference Dependence in the UK Property Market

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Abstract:

The study of reference dependence in property markets is of practical importance due to the unusual characteristics of property transactions, such as high information asymmetry caused by many individuals' lack of experience in property markets. The overall low transaction frequency and general illiquidity of property markets can exacerbate and reinforce irrational behaviours such as reference dependence. The knowledge gained through an empirical investigation in the UK property market can assist in the attenuation of these distortions. We use a UK online panel data provider, *Prolific*, to conduct an online experiment on the formation and adaptation of reference points among home buyers and sellers in the UK. Over 600 valid responses were collected in January 2019. By analysing the reported 'willingness to pay' of buyers and 'willingness to accept' of sellers this paper identifies the presence of behavioural biases in the UK property market, and the extent to which they are caused by both historical and recent prices. The influence of aspirations and social comparisons is established in this novel context. The results of the experiment clearly indicate that reference dependence is prevalent in the UK property market, and both aspiration and social comparisons affect reference point dependence significantly. The observed behavioural bias in housing decisions are "predictably irrational". The findings of this study pave the way for reliable economic modelling of such irrationality and a better understanding of behaviours in the housing market.

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Reference Dependence in the UK Property Market

1. Introduction

Traditional economic theory predicts that people will maximise their expected utility under uncertainty and seek to make a rational decision by considering all relevant information. However, observations and experimental evidence across various disciplines have highlighted the existence of irrational economic decisions resulting from several behavioural biases. Many researchers have attempted to integrate psychological understandings into classical economic models to provide an explanation for such observed irregularities.

Reference dependence, in the context of prospect theory (Kahneman and Tversky 1979), is the most popular of these explanations. The concept presumes that individuals exhibit behavioural biases because they evaluate choice outcomes as gains or losses around a reference point. As reference points are vital to the categorisation of a gain and loss domain, and therefore to overall choice outcomes, it is beneficial to obtain a good understanding of how they are formed and how they can be adapted. It is especially pertinent to study reference dependence in property markets due to their unusual characteristics, such as high information asymmetry caused by many individuals' lack of property market experience. Indeed, this could be exacerbated in the UK market, which recently saw homeownership fall to its lowest level in over 30 years (Evans 2017). Therefore, since Arkes et al. (2008) find that cultural factors bear some weight in reference point adaptations, this study of the UK property market fills an important cultural gap in the literature. Moreover, the overall low transaction frequency and general illiquidity of property markets can exacerbate and reinforce the observed irrational behaviours. However, the knowledge gained through an empirical investigation in the UK property market can assist in the attenuation of these distortions.

This study adapted and improved the analytical framework in Paraschiv and Chenavaz (2011), where reference dependence was studied in the French housing market. They recruited 434 respondents from universities, business schools, and online housing forums. The experiments were administrated online, and each respondent answered 14 hypothetical questions (9 for seller's role and then 5 for buyer's role). Their empirical findings support the notion that market evolution and available information influence reference point dynamics, which calls for further research in this direction. We improved their work in the following ways.

Firstly, Paraschiv and Chenavaz (2011) found that reference points depend on the seller/buyer role in the housing market. Yet in their experiment design respondents answered questions for both sellers and buyers. As the average completion time for the experiment was roughly 10 minutes, there is a potential risk that the respondents might not have fully switched to their role as a buyer when answering the last five questions, a factor that could confound the results. Therefore, we segregated the buyer and seller questions into two separate questionnaires, with one respondent taking either the buyer or the seller role, not both. This avoids participants confusing their market roles, thus strengthening the robustness of the findings.

Secondly, in an important work on reference point formation and adaptation by Baucells, Weber and Welfens (2011), intermediate prices are the least important determinants of reference point formation and adaptation. However, Paraschiv and Chenavaz (2011) found that this is not true, at least in the French housing market. As the current literature is somewhat

unclear on the influence of intermediate prices, we introduced two questions specifically testing the effect of historical peak and trough prices alongside the test of other intermediate prices.

Thirdly, we also considered two factors that are specifically relevant and important in housing markets: aspiration profits as reference points and the effect of social comparisons on the formation of reference points. At the time of writing, these factors have not been incorporated in reference point dependence studies in the housing market. However, given the fact that properties are seen as both consumption and investment goods, and are often used as a signal for social status, it is important to study the role of sellers' target profit level and the role of social comparison.

Finally, we used online panel data (OPD) in this study. This approach is a significant improvement over the traditional online survey method used in Paraschiv and Chenavaz (2011) in terms of sample representativeness and efficiency. An online panel is an electronic database of registrants who have indicated a willingness to participate in future web-based research studies. Examples of online panel data platforms include *Amazon Mechanical Turk* and *Prolific*. OPD and online panel participants have been gaining attention from researchers in social science studies. For example, Porter et al. (2019) pointed out that in 2017 there were 214 publications in the top 13 management journals reviewed that used OPD. It concludes that OPD is both cost-effective and reliable in many research areas, particularly for behavioural investigations. Given the cost and complexity of conducting behavioural studies in housing markets, it is worthwhile to explore the applicability of OPD in housing research.

The rest of the paper is organised as follows. Section 2 details the theoretical framework and its application to property markets before establishing the five testable hypotheses this study aims to answer. Section 3 explains the research methods used, including the experimental design and justification for the data collection method. Section 4 presents analysis of the data and reports the empirical results. The final section summarises the paper and offers areas for future research.

2. Theoretical Background and Testable Hypotheses

The most influential theory used to emphasise the importance of psychological aspects when modelling choice behaviour is prospect theory, developed by Kahneman and Tversky (1979). Prospect theory illustrates how people's observed risk-preferences systematically deviate from the predictions of standard economic theory (SET hereafter). Three fundamental behavioural aspects for modelling individual decision-making processes are presented by prospect theory: reference dependence, loss aversion, and diminishing marginal sensitivity. In this paper, we focus on the reference dependence element of prospect theory, as it is instrumental for the applications of prospect theory.

Reference dependence assumes individuals evaluate the outcome of a choice based on positive or negative changes relative to some reference point. This is contrary to SET which assumes individuals judge the outcomes of decisions on final states of wealth or assets. The following example is useful to further illustrate and clarify this point. Suppose a decision-maker is selling her apartment, SET suggests she is only concerned with the absolute outcome of her decision (selling the apartment for £500,000). However, if the decision-maker sells her apartment for £500,000 when she bought it for £520,000 she will perceive this as a loss according to prospect theory, since she is concerned by gains and losses relative to a reference point (initial purchase

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price in this example). Therefore, the reference point is particularly important as it determines how an outcome is judged.

The observed inconsistencies between actual behaviour and the predictions of SET have been the subject of much academic interest in the real estate domain. Studies show that the behaviour of housing valuers and appraisers can be subject to behavioural biases. Appraisers tend to seek evidence in support of initial beliefs they form during the valuation process (Clayton, Geltner and Hamilton 2001). These value judgements contribute to the formation of their reference point, which can then be influenced by other factors such as anonymous experts (Diaz and Hansz 1997) and even clients (Crosby et al. 2018). Indeed, when selecting comparable sales, valuers have been found to suffer from sale price anchoring bias and they tend to weight recently considered information more heavily. These findings are consistent with the idea that appraisers 'anchor' on previous appraisals leading to an appraisal smoothing effect (Diaz and Wolverton 1998; Geltner, MacGregor and Schwann 2003). Scott and Lizieri (2012) also find evidence that first-time buyers with little to no experience of the housing market are influenced in their decision-making by recently valued properties, as these serve as anchors for future valuations.

This use of heuristics in property valuation is potentially susceptible to manipulation by experienced real estate agents who, by influencing the anchor used in a buyer's initial value judgment, can increase the buyer's eventual offer price. However, widespread use and access to the internet diminishes the informational asymmetry advantage enjoyed by the real estate agent. Yet, as Scott and Lizieri (2012) note, this is still an important concept since the designers of online search algorithms can use this behavioural bias to their advantage and manipulate value perceptions in an even more powerful and subtle manner.

Although there is ample empirical evidence on reference dependence, the literature comes to little agreement on the nature of the reference point. Indeed, in their formalisation of prospect theory, Kahneman and Tversky (1979) do not provide guidance or rules for how reference points are formed. However, gaining a better understanding of how reference points are formed and manipulated can augment individuals' decision-making processes.

Moreover, the reference dependence literature tends to focus on seller behaviour relative to consumption goods. The behaviour of property buyers is seldom addressed. As such, it becomes inappropriate to compare the results directly to real estate markets, which are characterised by durable goods that experience low trading frequency. Paraschiv and Chenavaz (2011) add an important dimension to the current research on property market behavioural biases by identifying that the reference point is influenced by the buyer or seller role. However, whilst their findings are illuminating, it can be argued they are specific to the French housing market and therefore may lack general applicability. To reliably extrapolate the findings universally, similar studies must be undertaken in other national property markets. Indeed, the empirical evidence of behavioural biases in the UK property market is somewhat limited at present. This research aims to fill the gap in the literature by investigating reference points used by buyers and sellers in the UK property market, using a similar framework to Paraschiv and Chenavaz (2011).

The thrust behind conducting this research in the UK, despite the existence of empirical findings in other countries, lies in the heterogeneity of property markets. To apply behavioural findings from one market to another would be to ignore fundamental cultural differences, such

as level of homeownership, house price movements and percentage of income spent on housing, which have been shown to influence economic behaviours (Anderson et al. 2011; Chui, Titman and Wei 2010). There are disparities in the market evolution between national property markets in Europe (Boitan 2016). Therefore, since market evolution has been found to influence reference points (Paraschiv and Chenavaz 2011), the nonconformity of different property markets has potential to impact upon the formation of reference points.

In addition, this paper will innovate by investigating the effect that factors not previously applied to a property market context have on reference points. Specifically, this study will look at the role of aspirations and social comparisons in the property market in terms of an 'aspiration profit'.

The aspiration profit is defined as the level of profit that the seller would like to make between when they bought it and when they eventually sell it. There is ample evidence from the labour market to suggest that workers, specifically those that are free to choose the hours they work in a day, tend to serve a target or 'aspiration' level of income instead of maximizing their daily income (see, for example, Camerer et al. 1997; Fehr and Goette 2007). This seemingly illogical result can be explained by an 'aspiration daily income' being used as a reference point. Home sellers will likely be affected by an aspiration profit because houses are both durable consumption goods and financial investments. In fact, this dual role of houses has significant implications for individuals' decisions regarding housing and non-housing consumptions (Cerny, Miles and Schmidt 2010; Hung and So 2012; Yang, Fan and Zhao 2018). Therefore, it is important to verify whether aspiration profit affects reference point formation among home sellers in the UK.

Similarly, the effect of social comparisons, or the tendency for people to compare their lifestyles to the lifestyles of those around them, will be investigated as well. The idea that individuals compare themselves socially has mainly been studied in the context of Leon Festinger's Social Comparison Theory (Festinger 1954). Humans possess a "drive to evaluate" their opinions and abilities and, where possible, they will compare themselves to others. Decisions are rarely made in the socially isolated conditions adopted by most of the literature in this area, and hence the social context should be considered in the field of decision-making under risk (Linde and Sonnemans 2012). One conceptualisation of the reference price is that it represents a normative price, that is, the price the buyer believes to be 'fair' for the seller to charge (Bolton, Warlop and Alba 2003; Campbell 1999). Viglia and Abrate (2014) found that when the source of information is social, in this case information obtained from their peers or colleagues, participants tended to lower their reference point. Unfortunately, the literature on the effect of social comparisons on reference points is limited and, to the best of our knowledge, is non-existent in a property market context. Our research bridges this gap in the literature by considering the role of social comparison in reference formation in the housing market.

Based on the literature reviewed above, this study aims to investigate how reference points are formed by both buyers and sellers in the UK property market. Our research is developed using the analytical framework in Paraschiv and Chenavaz (2011) by investigating the role of initial purchase price, intermediate prices and recent prices in reference formation. We also extend the work in Paraschiv and Chenavaz (2011) by considering the effect of aspirations and social comparisons in reference point formation. A total of five hypotheses are derived as outlined below.

Hypothesis 1: Initial purchase price is used as a reference point

Often the most salient reference point is the price the property was initially purchased for, as it acts as a natural indicator for whether money has been gained or lost on a transaction. Although many reference points are context-dependent, initial purchase price is one of the few that has been proven significant across different contexts. For example, Leung and Tsang (2013) found support for initial purchase price as the reference point using empirical evidence from the Hong Kong property market. Whereas, Genesove and Mayer (2001) and Einio, Kaustia and Puttonen (2008) use initial purchase price as a reference point to explain loss aversion in the Boston apartment market and the Greater Helsinki area respectively. It would seem, therefore, that initial purchase price has been well-studied and proven to be used as a reference point in a variety of contexts.

Hypothesis 2: Intermediate prices are used as reference points

An intermediate price, for this study, is that price which is observed after the initial purchase price and before the current price of the property. This includes both linear increases/decreases and historical peaks/troughs in price. There is evidence of a historical high/low serving as reference points for stock investors (Simonsohn and Loewenstein 2006), and home sellers (Seiler et al. 2008). Paraschiv and Chenavaz (2011) determine that non-extreme intermediate prices have less of an impact than extreme ones, such as a historical peak, and show that individuals actually shift their reference points towards the historical peak. These findings provide a fairly strong indication that intermediate prices, particularly historical peaks, affect reference points.

Yet, there are important empirical results that contradict this view. For example, Baucells, Weber and Welfens (2011) adapted the experimental design of Arkes et al. (2008) enabling them to directly observe the reference point formation process. The purchase price and current price of the time-series seem to be the main determinants of the participants' reference price, while intermediate prices are relatively unimportant. The implications of the current findings on intermediate prices are therefore somewhat contradictory. As such, this investigation of intermediate prices as reference points in a UK property market context is a useful and necessary extension of the current literature that can hopefully bring some clarity to the current findings.

Hypothesis 3: Recent prices are used as reference points

Recent prices take on a slightly different meaning for a buyer and a seller in this study. For a seller, a recent transaction price of a similar property may act as a reference point for their valuation of their own property. Whereas, for a buyer, knowledge of an alternative offer received for a similar property may act as their reference point. Consequently, for a buyer, information of an alternative offer for the property is introduced in the hypothetical scenarios, while information about a recent transaction price of a similar property is introduced for sellers.

The value of ascertaining the impact of recent prices on reference points is heightened in property markets as the fundamental value of properties is often difficult to discern for outsiders and the low transaction frequency of properties exacerbates information asymmetry. Both recent transaction prices and alternative offers contain valuable, up-to-date information about the property. Not surprisingly, Paraschiv and Chenavaz (2011) find that the introduction of an alternative offer price shifts buyers' reference points further than when initial purchase

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price is introduced. This result suggests recent information is weighted more highly than past information in the formation of reference points, supporting the findings of Baucells, Weber and Welfens (2011). Applying these findings to the housing market is a logical step as the results suggest that the effect of certain information is weighted differently.

Hypothesis 4: Aspirations affect reference point formation

An individual's aspirations tend to be drawn from past personal experience and are acutely affected by their social environment; we often look at the experiences and achievements of our peers to shape our own goals (Genicot and Ray 2017). We seek to establish if the profit a seller wishes to earn on their property, the 'aspiration profit', affects the minimum price they will accept to sell it for.

The concept of applying an 'aspiration profit' to the property market is reasonable given the unique attributes of housing as an asset. For example, properties can enjoy unearned land value uplifts resulting from wider societal and infrastructural change in an area, which may occur despite no aspect of the property changing. Such market characteristics may result in agents expecting to sell their properties for more than they bought them. Similarly, the cyclical nature of the property market allows individuals who purchase their property at the bottom of the market to enjoy substantial value increases caused by market fundamentals rather than any active improvements they have made.

Hypothesis 5: Social comparisons influence reference point formation

Viglia and Abrate (2014) build on earlier work that looked at price sequences (Ariely and Zauberman 2000; Baucells, Weber and Welfens 2011), but control for the presence of social influence. They find that individuals appear to be averse to paying much more than their peers as they would categorise this as a 'loss' when using a social reference point. However, Linde and Sonnemans (2012)'s experimental findings suggest that we must be cautious when simply extending well-established theories of decision-making under risk to social situations.

The nature of housing markets may enhance the likelihood of individuals making social comparisons. Goethals (1986) notes that where there is no physical reality to compare to, people tend to make social comparisons to satisfy their need to evaluate their opinions and abilities. Therefore, the infrequent trading and lack of transparency in property market transactions may invite social comparison among property market participants. Consequently, this investigation into whether reference point formation is influenced by social comparisons is beneficial for gaining an improved understanding of what drives the observed behavioural irregularities in the property market.

3. Research Methods

Experimental Design

To test reference dependence in the UK property market we conducted a controlled experiment. Using this method allowed for explicit control of the participants' decision-making environment, making it possible to isolate the impact of important variables and identify any causal relationship between them (Rabin 2002). This extra influence and ability to isolate variables is what makes controlled experiments one of the most widely used research methods in behavioural economics. The hypothetical scenarios used in the questionnaires are summarised in Table 1.

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Buyers and sellers are segregated, improving on the design of Paraschiv and Chenavaz (2011), but both are put through the same ten hypothetical scenarios with the wording changed slightly to reflect their market role. The first four questions have been adapted to a growing market and a declining market. The seller questionnaire asked for the minimum price the respondent would be willing to sell the property for; the buyer questionnaire asked for the maximum price the respondent was willing to pay for the property. From this point onwards, the buyers' maximum buying price will be referred to as their 'willingness to pay' (WTP) and the sellers' minimum selling price will be their 'willingness to accept' (WTA).

Both questionnaires were specifically designed to determine the effect, if any, that certain information had on buyers' and sellers' WTP/WTA. Hypotheses 1-4 test the impact of four different types of reference points that buyers and sellers in the property market might use. To determine the presence of a behavioural bias, caused by reference dependence, the average market price had to first be established. According to SET, buyers and sellers would behave rationally and refer to this market price to form their WTP/WTA. This piece of information is provided to all respondents in Questions 1 and 5 as described in Table 1.

First, initial purchase price is introduced, followed by an intermediate price, and finally an alternative offer price (buyer) or a recent transaction price (seller). If buyers and sellers report a WTP/WTA that deviates from the market price following the introduction of new information, then we can conclude they are subject to a behavioural bias influenced by this new information. This incremental introduction of the information makes it possible to isolate the effect of specific information, as no other aspects of the scenarios are changed.

Among the 10 hypothetical scenarios common to both questionnaires, there were distinct blocks of questions that tested the effect of different information on reference points. As Table 1 illustrates, the first four questions examined the impact of introducing the price the property was purchased for, its intermediate price, and a recent transaction or offered price of the property. The second four questions replicated these scenarios but changed the market trend from a declining market to a growing market in which the property's value was increasing from the initial purchase price. Following the first eight questions, two questions were asked that sought to elicit the impact that learning of an historical peak or trough in the property's price had on the respondent's WTP/WTA.

The seller questionnaire then had an additional three questions that introduced the concept of a target or 'aspiration' profit that the respondent wants to earn when they eventually sell the property. They were then given the average market price of similar properties and asked what their WTA was. Hypothesis 4 was tested for three different levels of 'aspiration profit', to ensure robustness. Table 1 summarises the questions asked, and the column labelled 'Price Info' shows the information that is manipulated in each question to establish its effect on reference points.

Table 2 highlights which questions are used to test each hypothesis. For example, since the only difference between Question 1 and 2 is that respondents are informed of the initial purchase price, any difference observed in the reported prices of these questions can be attributed to this information. The same logic is true for Questions 5 and 6, except that the scenario is in a growing market condition. Hypothesis 1 is tested using this logic, with the pairs of questions used detailed in Table 2.

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Following the hypothetical scenarios, both questionnaires asked three questions that sought to determine the respondent's propensity for social comparisons. Initially, they were presented with a list of peers, for example 'a close friend', 'a neighbour' or 'a colleague', and were asked to select those which they had compared their lifestyle to. Participants were then asked how often they made these lifestyle comparisons and, on a scale of 0 to 10, how important it was that they were better off than the person(s) they had previously selected. These variables are then used as measurements of respondent's propensity for social comparisons in later analysis.

The final section of each questionnaire contained general demographic questions, including age, gender, highest educational attainment, average monthly income and average monthly housing expenditure. A list of these variables and their definitions can be found in Table 3.

Table 1 Scenario designs

Question	Label	Market Trend	Price Info
1	Average Market Price	Declining	Similar properties trade between £250,000 - £350,000
2	Initial Purchase Price	Declining	Four years ago, the property was bought for £400,000
3	Intermediate Price	Declining	Two years ago, the property was worth £350,000
4	Alternative Offer Price	Declining	A similar property has just sold for £250,000
5	Average Market Price	Growing	Similar properties trade between £450,000 - £550,000
6	Initial Purchase Price	Growing	Four years ago, the property was bought for £400,000
7	Intermediate Price	Growing	Two years ago, the property was worth £450,000
8	Alternative Offer Price	Growing	A similar property has just sold for £550,000
9	Historical Peak	-	Four years ago, price of the property was £300,000. You wanted to sell (buy) but deal fell through. Two years ago, the property's price had risen to £400,000. Recent valuation of £350,000 by real estate expert.
10	Historical Trough	-	Four years ago, price of the property was £300,000. You wanted to sell (buy) but deal fell through. Two years ago, the property's price had fallen to £200,000. Recent valuation of £250,000 by real estate expert.
11	Aspiration Level - Low	-	You bought a property for £500,000 several years ago. Set a target of earning at least £25,000 in profit when you sell. You now have to sell. Property currently valued between £525,000 - £575,000.
12	Aspiration Level - Mid	-	You bought a property for £500,000 several years ago. Set a target of earning at least £75,000 in profit when you sell. You now have to sell. Property currently valued between £525,000 - £575,000.
13	Aspiration Level - High	-	You bought a property for £500,000 several years ago. Set a target of earning at least £100,000 in profit when you sell. You now have to sell. Property currently valued between £525,000 - £575,000.

Note: All questions asked for the minimum price they would sell the property for. The buyer questionnaire asked the same questions 1-10 (questions 11-13 only used for sellers) as the seller questionnaire, with wording changed slightly to represent a buyer decision. The buyer questionnaire asked for the maximum price they would pay for the property. Where important, the wording of the buyer questionnaire has been included in parentheses in Table 1 to ensure clarity.

Table 2: Questions use to test hypotheses

Hypothesis	Questions used to test hypothesis
Hypothesis 1: Initial purchase price is used as a reference point	1-2, 5-6
Hypothesis 2: Intermediate prices are used as reference points	2-3, 6-7, 9, 10
Hypothesis 3: Recent prices are used as reference points	3-4, 7-8
Hypothesis 4: Aspirations affect reference point formation	11,12,13
Hypothesis 5: Social comparisons influence reference point formation	Questions 1 - 13

Table 3: Personal Traits of Respondents

Variable	Definition	Sellers	Buyers
Age	Age in years		
Less than 25 years old (AGE1)		2%	3%
25 - 35 years old (AGE2)		31%	35%
36 - 50 years old (AGE3)		40%	38%
51 - 65 years old (AGE4)		22%	20%
More than 65 years old		5%	4%
Gender	= 1 if male, 0 otherwise		
Female		75%	73%
Male (MALE)		25%	27%
Education	Highest education attainment		
Secondary school (EDU1)		11%	10%
Sixth form college (EDU2)		26%	22%
Undergraduate degree (EDU3)		42%	47%
Postgraduate and/or PhD (EDU4)		19%	20%
Others		2%	1%
Income	Average monthly income (£)		
Less than £500 (INCOME1)		11%	9%
Between £500 - £999 (INCOME2)		17%	15%
Between £1000 - £1999 (INCOME3)		43%	42%
Between £2000 - £3000 (INCOME4)		21%	24%
More than £3000		8%	10%
Housing expenditure	Average monthly housing expenditure (£)		
Less than £500 (HEXP1)		57%	55%
Between £500 - £999 (HEXP2)		39%	37%
Between £1000 -£1500 (HEXP3)		2%	5%
More than £1500		2%	3%
Social comparison - reference groups	Have you ever made a comparison between your lifestyle and the lifestyle of any of the following persons?		
A close friend (SOCIAL1)		76%	78%
A colleague (SOCIAL2)		61%	59%
A neighbour (SOCIAL3)		42%	46%
A family member (SOCIAL4)		70%	67%
Yourself in the past (SOCIAL5)		64%	67%
Other		3%	3%
None		10%	8%
Social comparison - frequency	How often do you compare your lifestyle to the person(s) you selected above?		
All the time (FRE1)		6%	8%
Frequently (FRE2)		17%	17%
Occasionally		68%	68%
Never		10%	7%
Social comparison –importance (IMP)	On a scale of 0 to 10 (10 being the most important), how important it is for you to be better off than the person(s) that you selected above?	3.27	3.61
Sample size		197	203

Note: Labels in brackets are the names of the independent variables used in the regression model given in section 4.

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We used the crowdsourcing platform *Prolific* to conduct the experiment online. The number of published papers in the social sciences that are using crowdsourcing data has surged in recent years (Porter et al. 2019). Yet some researchers remain sceptical about the use of online crowdsourcing platforms. Firstly, critics argue that participants are non-naïve to the studies, citing the emergence of 'professional survey takers' who participate in a high number of experiments and subsequently become aware of researchers' motives. However, studies have shown evidence that crosstalk between participants, as well as respondents intentionally attempting to participate in one study repeatedly, is nearly non-existent (Chandler, Mueller and Paolacci 2014).

Secondly, there are fears that the quality of online sample data is inadequate due to respondents' inattentiveness or lack of effort, but substantial evidence suggests that attention levels of online participants either meet or exceed those from traditional sources (Behrend et al. 2011; Buhrmester, Kwang and Gosling 2011; Crone and Williams 2017; Goodman and Paolacci 2017; Ramsey et al. 2016).

Finally, the representativeness of online participants has been questioned but the evidence compellingly suggests that online samples are more representative of typical working adults than traditional university student samples used in many behavioural experiments (Crone and Williams 2017; Goodman and Paolacci 2017; Peer et al. 2017). Indeed, Casler, Bickel and Hackett (2013) compared the results of online crowd-sourced respondents with in-lab respondents who both completed a behavioural task. They determined the responses of the two groups to be equivalent and found the crowd-sourced participants were significantly more representative.

The main advantage that *Prolific* held over Amazon Mechinical Turk (or MTurk in short) was its abundance of UK respondents, with MTurk's respondents consisting of predominantly US (75%) and Indian (16%) citizens (Difallah et al. 2018). As our respondents should be UK homeowners, *Prolific* provides us with access to the target population.

Second, the extent to which we could pre-screen our sample was one of the main benefits of using *Prolific*. The platform is unique in that it allows researchers to apply various pre-screening filters to a sample at no extra cost, which enhances the researcher's capacity to gain a representative sample[2]. To gain the respondents required by this research it was necessary to filter the available population to ensure all eventual participants were homeowners. We set the pre-screening filter to be 'homeowners' such that only individuals who meet this criterion can participate in our experiments. To confirm the integrity of this filter, a question was included in each questionnaire that asked whether respondents had ever owned a home.

The process was highly time-effective. When creating a study, the required number of responses is set by the researcher and then *Prolific* notifies all eligible participants that they can participate in it if they want. For this research 400 responses were required, split between the buyer and the seller questionnaire. All the responses were collected within 3 hours, indicating this was a time-efficient method of collecting a considerable amount of data. The

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[2] The filters are not visible to potential participants and works on existing information in user profiles. Hence workers (i.e., members to answer questionnaires at Prolific) cannot change their profile in order to meet the selection criteria in a specific experiment.

process was also cost-effective. Total cost per participant, inclusive of *Prolific*'s fees, was £0.80 for the buyer questionnaire and £0.93 for the seller questionnaire. This is significantly lower than the fixed payments paid in similar experiments, such as the $8 paid to participants by Baucells, Weber and Welfens (2011).

Prolific also gives researchers the opportunity to select and reject responses that they consider unsatisfactory, prior to payment of the participant. This ensures all data was of a high standard, further increasing the cost-effectiveness of this method. In total, 37 responses were deemed to be unsatisfactory and were rejected, yielding a rejection rate of 8.5%. For example, responses completed in under 3 minutes were rejected on the basis that this was too quick a response for the participants to have given the questions the required level of attention. Note that the rejection rate in this context refers to the number of rejections made by the researcher as a proportion of total responses received.

In the last two columns of Table 3, we summarised the average responses from the seller and buyer subsamples respectively. Respondents in the two groups are very similar in their profiles, such as age and income distributions. There are a small proportion of respondents who chose the 'Others' category when answering the social comparison (reference groups) question. The vast majority of these answers are 'celebrities' or 'people who I know from social media'. Unlike the other four categories in this question, these are not tangible individuals in one's life, and are unlikely to serve as valid social comparison reference groups. The proportion of the responses is also very small, i.e., 3% in both subsamples. We therefore did not consider this category in our later analysis.

4. Empirical Findings and Discussions

Tables 4 and 5 summarise responses from the buyers and sellers experiments respectively. The 'SET Predictions' column contains the prediction of SET based on the information given in Questions 1 and 5 (i.e., the average market prices). The 'Manipulated Information' column gives the new information provided in each corresponding question (further information can be found in the last column of Table 1). The 'Average Reported Prices' column presents the average responses to each corresponding question. The 'Deviation from SET Predictions' column contains the difference between figures in the 'Average Reported Prices' column and the 'SET Predictions'. If figures in this column are significantly different from zero, it is evidence of deviation from the SET predictions. Finally, the 'Price Distribution' panel shows how reported prices in each question are distributed around the SET predictions, providing further information for the 'Deviation from SET Predictions' column. Specifically, the "Lower", "SET Predictions", and "Higher" columns contain the proportion of responses that are below, equal, and above the SET predictions respective.

To verify the statistical significance of identified biases in Tables 4 and 5, we performed paired two-sample t test on each of the question pairs given in Table 2, and one-sample t test on the difference between average responses to questions 9 – 13 and their corresponding SET predictions. This evidence is used to test hypotheses 1 through 4, and the results are reported in Table 6.

Hypothesis 5 is tested by using linear regressions, with differences in responses between question pairs in Table 2 (i.e., for questions 1 – 8) or differences between average responses and SET predictions (i.e., for questions 9 – 13) as the dependent variable, and social

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comparison measurements as the key independent variables. The general model specification is given below.

$$ln(abs(Bias_i) + 1) = \beta_0 + \beta_1 AGE1 + \beta_1 AGE2 + \beta_1 AGE3 + \beta_1 AGE4 + \beta_1 MALE + \beta_1 EDU1$$

$$+\beta_1 EDU2 + \beta_1 EDU3 + \beta_1 EDU4 + \beta_1 INCOME1 + \beta_1 INCOME2 + \beta_1 INCOME3$$

$$+\beta_1 INCOME4 + \beta_1 HEXP1 + \beta_1 HEXP2 + \beta_1 HEXP3 + \beta_1 SOCIAL1 + \beta_1 SOCIAL2$$

$$+\beta_1 SOCIAL3 + \beta_1 SOCIAL4 + \beta_1 SOCIAL5 + \beta_1 FRE1 + \beta_1 FRE2 + \beta_1 IMP + \varepsilon \,,$$

The definition of each independent variable can be found in the first column of Table 3. $Bias_i$ is defined either as the difference between answers to question pairs or the difference between answers and the corresponding SET predictions. The absolute values (i.e., the $abs(.)$ function in the above equation) of $Bias_i$ is used because the direction of biases does not matter. We used natural log transformation of all dependent variables to facilitate the comparison of coefficient estimates among models. Because the minimum value of $abs(Bias_i)$ is zero (i.e., the reported WTP/WTA equals the SET prediction), we add one to the results so that the natural log transformation can be performed. In total there are 11 models estimated for sellers, and 8 models for buyers. The specific definition of the dependent variable in each model is reported in the top panel in Tables 7 and 8. For example, to investigate effect of initial purchase prices on the deviation from SET predictions, the dependent variable is $ln(abs(Q_2 - Q_1) + 1)$ for both sellers and buyers. These models are estimated by OLS, and the results are reported in Tables 7 and 8. The test of each hypothesis is discussed below.

Hypothesis 1: Initial purchase price is used as a reference point

The average market price referred to in Tables 3 and 4 is established in Question 1 and Question 5 in a declining and growing market respectively. The reported responses in both questions are close to the SET predictions (i.e., £300,000 for Question 1 and £500,000 for Question 5). This means that both sellers and buyers are able to predict market price rationally, in the absence of information manipulation.

Question 2 and Question 5 then introduce the initial purchase price. Both sellers and buyers changed their WTA/WTP accordingly. For example, sellers increased their WTA by more than 25% in a declining market to be closer to the initial purchase price, while buyers' adjustment is more modest (i.e. about 10%) in a similar setting. Initial purchase price has a stronger reference point effect in a declining market than in a growing market, for both sellers and buyers, and affects sellers' reference point formation more than buyers, particularly in a declining market. Despite the differences in the responses among buyers and sellers, as well as in different market conditions, the effect of initial purchase price in reference point formation is statistically significant across the board, as can be seen in the first row in Table 6.

The results support Hypothesis 1, that initial purchase price is a reference point, as sellers'/buyers' WTA/WTP deviates from the SET predictions. As such, there is a clear behavioural bias and they do not rationally refer to the average market price as SET would predict.

Hypothesis 2: Intermediate prices are used as reference points

We then introduced a non-peak intermediate price in Question 3 and Question 7 for a declining and growing market respectively. Sellers and buyers altered their WTA or WTP towards this

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price accordingly. For example, in Table 3 the average WTA reported in Question 3 was 17.66% higher than the SET prediction now, or a downward adjustment of 9% from the average WTA reported in Question 2. This highlights that when the intermediate price is closer to the current market price or SET prediction, sellers adjusted their WTA towards it. The price distribution also suggests that a higher proportion of respondents reported a WTA closer to the SET prediction, suggesting the intermediate price is being used as a reference point.

Indeed, the use of an intermediate price as a reference point seems to persist, regardless of market conditions. Question 7 in Table 3 looks at intermediate prices in a growing market and finds some level of deviation. Although the magnitude of the deviation appears to be smaller for the growing market compared to the declining market condition, both are highly statistically significant (see Table 6). We also observed very similar patterns among buyers too (see Table 5).

The relevance of a historical peak/trough in price was also investigated. Question 9 introduced a scenario whereby the seller's property had increased in value to a peak in price several years ago, but the market had subsequently fallen to the low current price. Question 10 followed the same structure but in the opposite market scenario, to elicit the effect of a historical trough in price. The findings indicate that information about a historical peak in price do lead to irrational distortions in WTA/WTP. Table 5 shows that the differences between the reported WTA/WTP and the average market price in both scenarios was highly statistically significant.

The findings seemingly run counter to the results of Baucells, Weber and Welfens (2011) who found relatively weak to no influence of historical peak and trough prices. However, their study uses stock prices rather than property prices, suggesting the disparity in results could be a consequence of the asset market studied. Price information is more valuable in the property market due to infrequent trading and lack of transparency in valuation compared to the stock market. This interpretation is supported by Seiler et al. (2008) who noted that, in the real estate market, sellers experienced higher regret if they failed to sell at an all-time peak in price. Therefore, we conclude the results support Hypothesis 2; intermediate prices are used as reference points, and this remains the case when the intermediate price is a historical peak or trough.

Hypothesis 3: Recent prices are used as reference points

Additionally, the results support the idea that recent prices were used as reference points. For sellers, Question 4 introduces information about a similar property that recently transacted below the market price. Following the introduction of this information, sellers' average WTA drifted by 3.81% below the SET prediction, as shown in Table 3. Indeed, just over 82% of sellers do not refer to the average market price when they are aware of a recent transaction price. 57.36% of this deviation is accounted for by sellers reporting a WTA below the market price, clearly showing their behavioural bias has been influenced by the recent price. Moreover, in a growing market, as shown in Question 8 in Table 4, the recent price also produces a statistically significant deviation in WTA, but in an opposite direction. The same patterns are observed for buyers as well, as demonstrated in Table 5. All observed deviation from SET predictions are statistically significant at the 1% level, as reported in Table 6.

By investigating the effect of recent prices on sellers, we have built upon the findings of Paraschiv and Chenavaz (2011) who only looked at the effect on buyers. The results seem to

suggest that, in a declining market, recent prices have a greater effect on buyers than sellers, whereas in a growing market the opposite is true. Buyers are likely to reduce their WTP if they learn of a low alternative offer, as they will feel like they are in the loss domain and getting a 'bad deal' by referring to the market price. Sellers are likely to increase their WTA if they learn of a high recent transaction price, as they are unwilling to settle for a 'worse deal' by selling at the market price, which becomes part of their loss domain. These results are supported when the recent price is used as the reference point as it will change the boundaries of the gain and loss domains in this way. As such, it can be said that the results confirm the notion that recent prices influence respondents' WTP/WTA by acting as a reference point.

Hypothesis 4: Aspirations affect reference point formation

Questions 11, 12 and 13 were used to test Hypothesis 4. Each question instructed the seller to imagine that when they bought their property they had wanted to earn a certain level of profit on it when they eventually sold it. The desired level of profit was increased in each subsequent question. For example, the difference between Question 11 and the SET prediction tested the influence of a low aspiration profit, whereas the difference between Question 13 and the SET prediction tested a high aspiration profit.

SET predicts that sellers use the average market price given in the question as their WTA, so any deviation from this market price would indicate a behavioural bias and suggest aspirations influence reference point formation. Indeed, the responses do seem to be influenced by the introduction of an aspiration profit, as reported in the last three rows in Table 4. The results show that sellers adapt their WTA towards the aspiration profit, regardless of its size, suggesting that aspirations influence the behavioural biases of sellers in the property market.

By performing one-sample t-tests on the responses it was possible to determine whether the reported WTA differed significantly from the SET prediction. Table 6 illustrates that for all levels of aspiration profit, the observed differences are statistically significant at the 1% significance level.

Hypothesis 5: Social comparisons influence reference point formation

To establish whether social comparisons influence reference point formation, several key social comparison variables were collected within the questionnaire. Participants were also asked a series of basic demographic questions which were used to control for these characteristics during the regression. Since the answers to these questions consisted primarily of categorical data, it was necessary to translate them into a series of dummy variables. In total each model included 26 independent variables (see Table 3 for variable definition and descriptive statistics).

The dependent variable for each model was the difference in WTP/WTA caused by the introduction of each new piece of information. The questions that are used in deriving these independent variables are shown in the first row in Tables 7 and 8. The results of these regression models are shown in Table 7 for sellers and Table 8 for buyers. The discussions in this section are based on coefficient estimates that are statistically significant at the 10% level or lower, as highlighted with asterisks in Tables 7 and 8. Three observations can be drawn from these models.

First, the behavioural bias is primarily psychological and can only be marginally explained by observable demographics factors. This is evident from the low R squares reported for all models in Tables 7 and 8. Specifically, these factors can explain between 10.25% to 18.34% of the variation of the observed behavioural bias. As the data were generated in a controlled environment that allows little room for other confounding factors, we conclude that the observed bias is indeed primarily due to the psychological responses to each of the reference dependence determinants introduced in the experiments.

Second, the size of the effect of demographic factors is not negligible. For example, males and older people are more rational in housing decisions in general, although older sellers are more likely to be affected by their aspiration profit levels; higher education attainment seems to help reducing the size of bias for both sellers and buyers. The absolute values of these coefficient estimates are all greater than 1, which translates to an 100% changes from the base category due to the natural log transformation of the dependent variables. The moderating effect of these demographic factors on behavioural bias is economically significant.

Finally, social comparison can influence the size of behavioural bias, but the size of the effect is relatively small. We examine the influence of social comparison by identifying possible social groups to compare with (i.e., variables SOCIAL1 – SOCIAL5, representing a close friend, a colleague, a neighbour, a family member, or oneself in the past respectively) and the level of social comparison (i.e., variables FRE1 and FRE2 to measure the frequency of comparison, and IMP to measure the importance of social comparison to each individual). We find that comparing to a neighbour actually leads to the smallest behavioural biases among all social groups considered. This pattern holds true for both sellers and buyers. Using other social comparison groups tends to increase behavioural bias in housing decisions, but the pattern is weaker. On the other hand, comparison frequency does not affect the size of the bias, but the self-reported importance of social comparison does. This is particularly true for buyers, because the coefficient estimate of IMP is positive and significant in five of the eight models estimated.

The size of these coefficient estimates, albeit statistically significant at the 10% level, are generally smaller than that of the demographic factors. For example, the coefficient estimate of IMP in the first model in Table 7 is 0.24. Because the standard deviation of IMP is 2.70 for sellers, a one standard deviation change in IMP will lead to a 64.8% change in the bias caused by initial purchase prices. This is small when compared with the coefficient estimates of most of the demographic factors.

In summary, we found some general support for Hypothesis 5 and conclude that social comparisons influence reference point formation. A qualification to this conclusion is that social comparisons seem to be more influential for certain reference points – specifically the reference points that are formed from new and contemporary information, such as a recent transaction price or an alternative offer price. Moreover, social comparisons also appear to significantly influence sellers' WTA when an aspiration profit is used as a reference point. This is likely due to the general comparative nature of aspirations and the social environment in which they are usually formed; we often look to the experiences and achievements of our peers to form our own aspirations and goals (Genicot and Ray 2017).

Table 4: Seller Behaviour under Different Market Conditions

Question	Label	Market Trend	SET Predictions (£000's)	Manipulated Information (£000's)	Average Reported Price (£000's)	Deviation from SET Predictions	Price Distribution % Lower	SET Predictions	Higher
1	Average Market Price		300	--	293.223	-2.26%	43.15%	22.84%	34.01%
2	Initial Purchase Price (High)	Declining	300	400	379.972	26.66%	3.05%	6.09%	90.86%
3	Intermediate Price	Market	300	350	352.995	17.66%	3.05%	8.63%	88.32%
4	Recent Transaction (Low)		300	250	288.576	-3.81%	57.36%	17.77%	24.87%
5	Average Market Price		500	--	486,914	-2.62%	47.21%	30.96%	21.83%
6	Initial Purchase Price (Low)	Growing	500	400	452.426	-9.51%	76.65%	13.71%	9.64%
7	Intermediate Price	Market	500	450	470.365	-5.93%	70.56%	19.29%	10.15%
8	Recent Transaction (High)		500	550	520.315	4.06%	12.18%	26.90%	60.91%
9	Historical Peak	--	350	400	358.985	2.57%	12.18%	49.24%	38.58%
10	Historical Trough		250	200	255.822	2.33%	19.29%	50.25%	30.46%
11	Aspiration Level (Low)		550	25	539.107	-1.98%	55.33%	33.50%	11.17%
12	Aspiration Level (Medium)	--	550	75	565.919	2.89%	5.08%	22.34%	72.59%
13	Aspiration Level (High)		550	100	571.916	3.98%	4.06%	19.29%	76.65%

Table 5: Buyer Behaviour under Different Market Conditions

Question	Label	Market Trend	SET Predictions (£000's)	Manipulated Information (£000's)	Average Reported Price (£000's)	Deviation from SET Predictions	Price Distribution % Lower	SET Predictions	Higher
1	Average Market Price		300	--	305.148	1.72%	25.85%	37.56%	36.59%
2	Initial Purchase Price (High)	Declining	300	400	337.246	12.42%	11.82%	18.72%	69.46%
3	Intermediate Price	Market	300	350	322.736	7.58%	15.76%	21.18%	63.05%
4	Recent Transaction (Low)		300	250	281.882	-6.04%	65.52%	21.67%	12.81%
5	Average Market Price		500	--	494.902	-1.02%	32.68%	40.98%	26.34%
6	Initial Purchase Price (Low)	Growing	500	400	455.099	-8.98%	70.24%	16.59%	13.17%
7	Intermediate Price	Market	500	450	467.783	-6.44%	68.78%	19.02%	12.20%
8	Recent Transaction (High)		500	550	513.734	2.75%	22.93%	22.93%	54.15%
9	Historical Peak	--	350	400	346.305	-1.06%	27.80%	53.66%	18.54%
10	Historical Trough		250	200	237.635	-4.95%	48.78%	40.49%	10.73%

Table 6: Test Results for Hypothesis 1 through 4

Hypothesis	Null Hypotheses and Test Statistics			
Sellers				
Hypothesis 1 (Initial Purchase Prices)	$H_0: \mu_{Q1} = \mu_{Q2}$ -22,777***	$H_0: \mu_{Q5} = \mu_{Q6}$ 21.153***		
Hypothesis 2 (Intermediate Price)	$H_0: \mu_{Q2} = \mu_{Q3}$ 12.763***	$H_0: \mu_{Q6} = \mu_{Q7}$ -9.738***	$H_0: \mu_{Q9} = 350,000$ 6.266***	$H_0: \mu_{Q10} = 250,000$ 3.907***
Hypothesis 3 (Recent Transaction Prices)	$H_0: \mu_{Q3} = \mu_{Q4}$ 19.253***	$H_0: \mu_{Q7} = \mu_{Q8}$ -19.363***		
Hypothesis 4 (Aspiration Levels)	$H_0: \mu_{Q11} = 550,000$ -9.767***	$H_0: \mu_{Q12} = 550,000$ 14.279***	$H_0: \mu_{Q13} = 550,000$ 15.469***	
Buyers				
Hypothesis 1 (Initial Purchase Prices)	$H_0: \mu_{Q1} = \mu_{Q2}$ 9.844***	$H_0: \mu_{Q5} = \mu_{Q6}$ 13.939***		
Hypothesis 2 (Intermediate Price)	$H_0: \mu_{Q2} = \mu_{Q3}$ 6.208***	$H_0: \mu_{Q6} = \mu_{Q7}$ -7.461***	$H_0: \mu_{Q9} = 350,000$ -2.836***	$H_0: \mu_{Q10} 250,000$ -8.188***
Hypothesis 3 (Recent Transaction Prices)	$H_0: \mu_{Q3} = \mu_{Q4}$ 14.348***	$H_0: \mu_{Q7} = \mu_{Q8}$ -14.675***		

Note: The first line in each sell shows the questions that are used in the test. The second line in each cell is the t-test statistics and its statistical significance, which is indicated by the asterisks. P-value < 0.1 (*), p-value < 0.05 (**), p-value < 0.01 (***).

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Table 7: Test Results for Hypothesis 5 (Seller)

| | Reference Point Dependence Determinants (Dependent Variables) | | | | | | | | | | |
| Independent Variables | Declining Market | | | Growing Market | | | Historical Peak/Trough | | Aspiration Profit Level | | |
	Initial Price (Q2 - Q1)	Intermedia Price (Q3 - Q2)	Recent Price (Q4 - Q3)	Initial Price (Q6-Q5)	Intermedia Price (Q7 - Q6)	Recent Price (Q8-Q7)	Peak (Q9-350,000)	Trough (Q10-250,000)	Low (Q11 - 550,000)	Medium (Q12 - 550,000)	High (Q13 - 550,000)
INTERCEPT	9.76***	11.10***	5.71*	0.17	0.45	4.34	-1.90	0.54	0.69	5.44	5.09
AGE1	-1.34	-1.59	-1.12	-1.1	1.86	-0.98	2.48	0.26	5.50*	1.54	0.10
AGE2	-1.28	-3.81*	-2.85*	-1.87	-2.74	-1.76	0.26	-0.86	4.36**	-1.13	0.07
AGE3	-1.42	-4.08**	-2.98**	-2.56	-2.4	-3.00**	0.89	0.29	3.66**	-0.65	-0.35
AGE4	-0.82	-2.95	-1.40	-0.18	-2.27	-1.02	1.84	-0.58	4.14**	0.01	1.23
MALE	-1.14**	-2.32***	-0.42	0.04	-0.05	0.62	1.11	-0.67	1.18	-1.45**	-0.69
EDU1	0.81	-4.61	1.37	4.65	1.46	4.99**	3.19	-0.31	1.65	-1.41	-0.05
EDU2	1.08	-2.41	5.19**	4.87*	2.01	6.11***	1.35	-0.98	-0.30	1.06	1.06
EDU3	1.37	-2.37	3.03	4.76*	1.65	5.69***	1.70	-1.24	-0.63	0.67	1.45
EDU4	0.66	-3.26	4.08*	4.58	0.69	4.9**	2.84	-1.85	-1.80	1.13	1.53
INCOME1	-2.01*	-2.94	-0.23	0.81	0.27	-2.75*	-0.63	0.52	1.18	1.66	1.32
INCOME2	-1.41	-1.89	-0.25	1.98	2.54	-2.20	1.63	1.67	0.46	1.81	0.86
INCOME3	-1.15	-1.50	0.38	0.29	1.20	-1.75	0.81	0.02	0.07	1.51	0.25
INCOME4	-2.35**	-1.42	0.01	0.09	-0.95	-1.46	0.03	-1.33	1.65	0.87	0.25
HEXP1	1.77	2.97	0.82	3.51	3.94	2.03	2.37	4.23	-0.26	1.87	0.82
HEXP2	2.35	4.17	1.13	3.52	3.78	1.6	3.04	3.98	0.25	0.33	-0.47
HEXP3	3.53	-0.36	1.15	5.58	6.43	4.28	-4.11	1.08	0.80	3.31	3.35
SOCIAL1	0.94	0.53	1.83*	-0.4	2.04	0.57	0.04	1.85	-0.83	0.38	2.02**
SOCIAL2	-0.02	-1.21	0.77	-0.06	-0.01	-0.36	-0.76	-0.16	1.97**	-0.58	-0.22
SOCIAL3	-1.37**	-0.33	-2.16***	-0.05	0.04	-1.46**	0.58	-0.90	0.03	0.33	0.29
SOCIAL4	0.04	0.08	0.03	0.32	-0.88	1.45*	1.35	-0.94	1.18	-0.12	0.78
SOCIAL5	-0.54	0.04	0.22	-0.52	-0.16	-0.11	-0.22	1.53*	0.51	-0.01	-0.47
FRE1	-0.73	-0.93	-0.36	0.92	-0.21	-0.73	2.01	-0.57	-0.29	1.69	0.98
FRE2	-0.68	-0.26	-0.57	0.51	-0.18	-0.36	1.02	-0.50	0.57	0.51	-0.61
IMP	0.24**	0.35**	0.09	-0.01	0.07	0.15	-0.04	0.24	-0.04	-0.03	-0.17
R Square	0.1542	0.1606	0.1743	0.1025	0.1276	0.1885	0.1176	0.1118	0.1625	0.1350	0.1553

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Table 8: Test Results for Hypothesis 5 (Buyer)

Independent Variables	Reference Point Dependence Determinants (Dependent Variables)							
	Declining Market			Growing Market			Historical Peak/Trough	
	Initial Price (Q2 - Q1)	Intermedia Price (Q3 - Q2)	Recent Price (Q4 - Q3)	Initial Price (Q6-Q5)	Intermedia Price (Q7 - Q6)	Recent Price (Q8-Q7)	Peak (Q9-350,000)	Trough (Q10-250,000)
INTERCEPT	-2.29	1.17	8.26**	-3.33	-5.22	3.69	3.35	0.25
AGE1	0.66	1.32	-1.82	-0.32	0.14	-1.81	3.65	1.09
AGE2	-2.49	-3.17	-1.73	0.17	3.92*	-1.77	-1.96	-0.29
AGE3	-2.00	-3.53*	-2.14	0.06	2.58	-1.99	-2.40	-1.03
AGE4	-2.02	-3.08	-2.36	0.95	2.02	-2.59	-1.49	-0.51
MALE	-0.12	-0.70	0.82	-0.16	0.13	0.72	-0.56	-2.04**
EDU1	5.79	6.51	5.90*	6.93*	5.47	1.88	6.23	9.83***
EDU2	4.96	4.69	4.63	7.97**	4.88	3.63	5.79	7.85**
EDU3	5.79	4.68	4.21	8.50**	6.26*	3.20	5.07	7.66**
EDU4	5.00	5.05	3.23	6.85*	4.22	2.34	4.69	7.19**
INCOME1	1.96	0.62	-0.66	0.90	2.02	-1.12	-0.14	3.64**
INCOME2	2.75*	1.02	0.44	2.38	1.26	-2.18	0.81	0.63
INCOME3	2.67*	1.76	-0.03	2.62*	1.35	-0.02	2.26	3.69***
INCOME4	1.53	0.77	0.72	1.24	-0.41	-1.93	0.90	2.29
HEXP1	2.25	1.20	-2.20	-0.03	0.27	3.04	-3.85*	-5.05**
HEXP2	2.54	1.13	-3.20	0.25	-0.59	2.78	-4.83**	-5.86***
HEXP3	2.28	2.45	-0.42	2.22	1.17	4.68*	-1.87	-2.26
SOCIAL1	0.99	0.90	-1.48	-0.54	0.02	0.58	0.21	0.79
SOCIAL2	1.68	-0.35	1.62*	0.18	-0.61	0.06	-1.04	-1.51
SOCIAL3	-2.10**	-0.74	0.13	-0.17	-0.01	0.61	0.15	-0.21
SOCIAL4	0.68	-0.66	-0.04	0.83	0.82	0.18	0.18	-0.40
SOCIAL5	-1.30	-0.90	-0.96	-1.23	-0.06	-1.38	0.68	1.38*
FRE1	2.54	1.61	-1.64	0.39	-0.09	-1.82	0.15	1.18
FRE2	0.52	0.49	-1.46	-0.33	-0.89	-1.45	-0.20	0.56
IMP	0.16	0.01	0.27*	0.27*	0.40**	0.33**	0.13	0.31**
R Square	0.1629	0.1126	0.1264	0.1072	0.1409	0.1287	0.1329	0.1834

5. Conclusions

Observed behavioural irregularities in decision-making under uncertainty are thought to be caused by several behavioural biases. This paper conducted a controlled experiment to gain further insight into reference dependence in the UK property market. The experimental design of Paraschiv and Chenavaz (2011) was adapted and improved upon, using the theoretical framework of prospect theory, to answer the five testable hypotheses. The first key improvement to the experimental design is the segregation of the buyer and seller questions into two separate questionnaires. This enhanced participants' ability to identify with their market role, thus strengthening the robustness of the findings. Secondly, questions specifically testing the effect of historical peak prices were introduced alongside the test of other intermediate prices, as the current literature is somewhat unclear on their influence. Thirdly, the application of aspiration profits as reference points and the effect of social comparisons on the formation of reference points were applied to a property market context for the first time. Finally, we used an OPD platform to conduct the experiment with UK homeowners. This approach is a significant improvement over the traditional online survey method used in Paraschiv and Chenavaz (2011) in terms of sample representativeness and efficiency.

The results of the experiment clearly indicate that reference dependence is prevalent in the UK property market. The empirical findings show that buyers and sellers in the UK property market use the initial purchase price, intermediate prices and recent prices as reference points, leading to seemingly irrational deviations in WTP/WTA. Moreover, when sellers had an 'aspiration profit' they wanted to earn, the deviation of their WTA from the average market price was found to be statistically significant. This result suggests that holding a desire to earn an 'aspiration profit' affected sellers' reference point formation.

We also found that the deviation of WTP/WTA from the SET prediction was primarily a result of psychological biases. Conducting a linear regression to find the influence of social comparison variables gave rise to the notion that an individual's propensity to compare their lifestyle to others can influence the formation of their reference point. For example, when sellers formed a reference point from a recent transaction price, certain lifestyle comparisons were found to influence their WTA. This conclusion holds true for both market trends studied. Additionally, certain lifestyle comparisons had an impact on WTA when an aspiration profit was introduced. For buyers, a similar result was obtained. For example, buyers that refer to alternative offer prices when forming their WTP were influenced by certain lifestyle comparisons, under both market trends studied. As a result, it can be concluded that social comparisons do influence reference point formation, albeit the size of the impact is relatively smaller than that of the demographic factors considered.

Clearly deviations from SET can be systematic, making the observed behaviour "predictably irrational" (Paraschiv and Chenavaz 2011, p.349) and consequently lending itself to economic modelling (Hack and von Bieberstein 2015). For behavioural findings to be useful in economic models, a detailed understanding of reference points is necessary. Indeed, de Meza and Webb (2007) note that the determination of the reference point is the "most problematic aspect of prospect theory" (p.71). Consequently, building on this paper's application of novel reference points to the UK property market, research into newly considered reference points can be integrated into existing housing models to enhance their predictive power.

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It is possible that social comparisons have greater influence over reference point formation when agents are influenced by some 'reference quality', rather than a 'reference price'. Indeed, Hardie, Johnson and Fader (1993) suggest loss aversion may be more important for quality attributes than for price, a result that could be beneficially applied to the property market due the natural heterogeneity in property characteristics. Therefore, this study's introduction of social comparison effects to a property market context could be extended to determine the effect of social comparisons on the formation of a 'reference quality'. An example of a property's 'quality characteristic' is the presence of a garage, which is likely to be considered a luxury in markets where space is at a premium. Consequently, buyers may be willing to pay more than the market value of a property with a garage as they will gain a social benefit from doing so. Of course, this derived 'benefit' relies on many different variables, such as social and cultural values of the area, including whether neighbours seek to 'one-up' each other or prefer to 'blend-in'. Nevertheless, this is an exciting and potentially fruitful avenue of further study.

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