

Systematic Differences in Test Results across Real vs. Virtual Shopper Laboratory Stores

Pierre DESMET* and John TRAYNOR**

* Professor, Université Paris-Dauphine and ESSEC Business School

** President & CEO, In Vivo BVA USA

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Abstract: To limit the risk of failure in marketing initiatives while preserving confidentiality, businesses employ tests carried out in shopper laboratory stores. Compared with real market testing, real or virtual tests in such stores can reduce costs, and facilitate implementation and control of the environment. This study confirms that tested in 'real' or 'virtual' environments, product and brand image evaluations bear comparison. However, it reveals significant differences in behavioural indicators supporting non-substitutability of data collection methods: virtual shopping behaviour is not real shopping behaviour. Shoppers spend more time in the virtual aisle, attention to price and prompted product recall are strongly modified, and there are major differences between regular buyers (more likely to buy their usual product in a virtual environment) and infrequent buyers.

Keywords: market analysis and response, experimental research, information processing, laboratory store, virtual store, shopper insights, packaging survey, price survey, new product survey, purchase behaviour.

1. Introduction

The development of computing and of virtual reality enables the credible and realistic proposition of a virtual laboratory that accelerates the process of new product development at every stage from technological development to the testing of marketing initiatives. Fast moving consumer goods (FMCG) product managers who want to test consumer reactions to their marketing initiatives can use several marketing research methods depending on the kind of initiative and its level of development. These methods range from test markets through limited test zones to laboratory stores. Because managers seek fast, valid tests that are hidden from their competitors, the current study examines real vs. virtual laboratory methods.

Each method has its advantages and disadvantages such that method selection depends on the context and what, precisely, researchers are seeking. It will be different for packaging screening, new product testing, simulated market testing, merchandising, or price testing. Shopper laboratory stores are adopted when the purchasing context (the store) has a major effect on the choice and when observation of behaviour is important, the decision process being influenced by both conscious and unconscious aspects.

Virtual shopping technologies are now readily available (Burke, 1996; Berneburg, 2008) and are used by research companies and major businesses such as Kimberly-Clark or Procter & Gamble (Byron, 2007). Compared with real lab stores, virtual stores offer various practical advantages: they enable work with as yet non-existent products and packages; they are flexible, easily accommodating changes in the test scenario; and they can be relatively inexpensive (e.g. enlisting images of competitor products rather than the actual products themselves). Virtual stores also provide a financial advantage (reduced cost) which may appear important at first sight relative to the size of investment in a test market. This advantage derives in part from savings in purchasing and logistical costs compared with a real

store or a test market, and in part from reduction in the elaboration costs of virtual products. However, the size of the cost advantage depends on the ratio between the modelling cost of the virtual product and the price of the real product. This means that the cost advantage could be small when the product price is low, as is the case for most FMCG products, as opposed to other categories such as electronic devices, wine, etc.).

Despite the various advantages offered by virtual tests, a further question that should be asked is whether disadvantages exist that offset these advantages.

The biggest threat takes the form of potential reductions in test validity given the shift from actual, more realistic shopping contexts to virtual, more artificial shopping contexts. Differences have been signalled by studies showing that methods of participant recruitment, simulation (notably the quality of visual reconstruction), and questioning have a significant effect on the nature and quality of the data (Frohlich & Oppenheimer, 1998; Saether-Larsen & Tjostheim, 2005; Jiang & Benbasat, 2007a; Fiedler & Haruvy, 2009).

Some results have already provided information on the bias created by virtual environments and virtual product presentation. For studies relying on rational behaviour (such as conjoint studies), the bias is small and the benefits obtained through virtual reality seem significant (e.g. Berneburg, 2007; Richarme & Colias, 2009). However, other results suggest more insidious effects: one comparative study found that the market shares of products in virtual and real stores were comparable in only 65% of the cases (Saether-Larsen & Tjostheim, 2005). A much earlier study took a dynamic approach based on a small sample of eighteen women to compare behaviours in real and virtual stores (Burke, Harlam, Kahn & Lodish, 1992). This study concluded that the measures from the virtual store (e.g. market share) were biased, but that they could approach those of the real store if all the information needed at the moment of purchase was well represented in the virtual store. Another

reservation relates to the greater effect of previous buying behaviour on purchasing in a virtual store (Burke, Harlam, Kahn & Lodish, 1992).

The objective of this study is thus to compare the shopping data from two types of lab store, real versus virtual, for purchasing behaviours, product and brand image evaluations, and product choices for a FMCG product (coffee) sold in self-service stores (super- and hypermarkets).

Using a multi-group methodology, this study produces two primary conclusions. The first is that most attitudinal indicators for the tested brand are comparable between the two environments: attribute ratings for packaging, brand, and price are similar (with some differences in absolute levels), suggesting testing mode has little influence on rational evaluation. However, the second conclusion is that behavioural indicators reveal major differences: shopping duration, visibility prompted product recall, and attention to price are strongly affected. This results in major differences among shoppers' profiles: regular buyers are more likely to remember and buy what they are used to buying when in a virtual as opposed to a real environment. Purchase behaviour but also declared future intent differs strongly, suggesting that a shopper's decision-making process (including habits, emotions, and navigation heuristics on top of rational evaluation) is affected by environmental factors (data collection mode).

In the next section we present the lab store methodology before turning to hypotheses and tests thereof. In section 3 we propose hypotheses regarding the link between virtual lab store context and consumer behaviour modification. In section 4 we present the methodology for testing the hypotheses and in section 5, we describe the results of our empirical analysis for one product category. In section 6, we summarize the main insights from our study and suggest research opportunities

2. Methodological Issues

2.1. Importance of the shopping environment

Research indicates that consumers adapt their purchasing process according to their objectives and the context in which they find themselves (Puccinelli et al., 2009). The plethora of information, products, and sensory stimulation assailing customers at the point of purchase are well documented, as are their effects on consumer behaviour (Inman, Winer & Ferraro, 2009). Faced with such a wide choice, purchasers use contingent decision strategies (the price example, Olshavky, Aylesworth & Kempf, 1995), enabling them to keep the duration of the decision to purchase the product down to a few seconds (Hoyer, 1984; Dickson & Sawyer, 1990). In addition, information processing capacity being limited, the purchasing process consists of both conscious and unconscious operations (Fitzsimons et al., 2002).

The habitual tendency in FMCG studies is, on the one hand, to integrate the understanding of shoppers as early as possible into marketing studies, and on the other hand, to pay more attention to methods based on observation, which allow measurement of the effects of context and provide keys to understanding.

2.2. Methodologies using a shopping environment

To replicate as closely as possible natural in-store behaviour, several test methodologies are available (Burke, 1996), which combine the store characteristic (real or virtual) and client purchasing behaviour (natural or 'acted'). There are currently two major options: real, autonomous stores or stores in a test zone, and shopper laboratory stores, controlled study spaces in which a store is recreated in reality or virtually.

An early solution, and the least intrusive, consists of a real launch in a real test store or a test zone. This option (real store, authentic behaviour) provides information with a strong

external validation, but poses significant technical and logistical problems that can reduce validity (e.g. running out of stock, competitors' marketing campaigns). In addition, this solution is expensive, late in the innovation process, and, above all, reveals the initiative to competitors.

A second solution involves reproducing a store in a laboratory and asking consumers to simulate their shopping. The main stakes are then the differences between real and acted behaviour due to the environment and the simulation task. The ability to develop a realistic environment is key as it has to stimulate the replication of all the processes involved in a consumer's choice, ranging from carefully following a shopping list to impulse buying. Other moderating effects have been observed to endanger external validity of behaviour in a lab context (Lewitt & List, 2007): the absence of other people which can influence decisions (social or ethical considerations), the context of the decision, the selection of participants, and simulation issues, i.e. acting.

2.3. Virtual laboratory store methodology

In a virtual lab store customers are immersed in the store. Through a classic interface (keyboard, mouse, or touch screen) or a virtual interface (sensors), they move around a replica store, visualize products and prices, can zoom in on packaging, and, eventually, can put the product in the virtual shopping cart that appears on the screen. The virtual universe provides for capture of information on shoppers' movement as they navigate around the 'store' and offers improved visual acuity with viewing angles and perspectives that are closer to reality. At a technical level, visual immersion through projection on a life-sized wall is favoured, bringing the interviewees closer to a large-format screen or even a 360° screen that make visual immersion total. However, certain sensations such as touch, weight, and odour, which arise during the choosing process, are not recreated even if the object can be handled virtually.

These virtual stores are more realistic than simplistic virtual displays in which shoppers are not subject to real immersion but have to choose products from only a static representation of the shelves, similar to the choice facing them in a vending machine. If a virtual display allows evaluation in a competitive situation on the basis of visual stimuli, it cannot reproduce a realistic store environment or even accurate product representation as, for example, larger products are displayed to compensate for screen size constraints.

Higher levels of immersion are so expensive that they are not common in marketing research. Such levels include virtual worlds of the *Second Life* type, where a consumer can have an ‘external’ view of a representation of their persona, their avatar, which they can prompt to act as they please (Jin, 2009); or multisensory immersion where the subjects are equipped with a network of receptive sensors that enable them to ‘feel’ the virtual world, a technique used for training when subjects must interact with a hostile environment. In this research we retain the virtual store methodology because it provides a credible shopping environment, but also for reasons of expense.

3. Hypothesis Development

Virtual reality is the experience of a reality simulated by computing science. Two important consequences ensue. First, the experience of ‘shopping’ in a virtual lab store is mediated by a human–machine interaction. This interface can alter behaviour significantly relative to behaviour in a real lab store where respondents move and shop as in a normal store. Second, the interaction with the product in virtual reality brings about a particular experience of ‘telepresence’ that creates immersion (Hoffman & Novak, 1996), and the interaction with the product in a virtual store is somewhat artificial, thus serving to reduce perceived risk, improve attitudes, and increase purchase intentions (Schlosser, 2003; Suh & Chang, 2006).

We study differences between real and virtual stores on three dimensions. The first step is to compare the shopping behaviour in terms of specific criteria such as purchase duration, attention devoted to product information, and attention devoted to price. The second step is to compare aggregated results from the brand point of view at the attitude and purchase levels. Finally, the third step is to understand respondents' experience of the task: perceived difficulty, the extent to which they enjoyed it, and the realism of their simulated shopping behaviour.

3.1. Brand indicators

At the brand level the first question is to evaluate differences between real and virtual lab stores for declared assessments for a specific product: visibility prompted recall and attitudes toward product attributes (pack, product, price) and toward the product as a whole. The second question is to study the differences for behaviours (the actual product chosen for purchase from among those on offer).

3.1.1. Product prompted recall

Product prompted recall from a photo (visibility) is an indicator of an *a posteriori* recognition of a product presented on the shelf. The ability to recall a product's presence is a proxy indicator that information about the product has been processed. The role of vision in the purchasing process is influenced by store type: in a real store, vision is both central and peripheral because the space in which the consumer moves is three dimensional; in a virtual store, as a result of interaction with a computer, product recall should be higher because (1) as attention is focused on a restricted space, i.e. the screen, the product information is more deeply processed and this makes product recognition easier; and (2) the reduced size of packs appearing on the screen also brings about active exploration that favours later recognition.

H1.1 Product prompted recall is higher in virtual than in real lab stores.

3.1.2 Attitude indicators for a specific product

As the shelves in virtual stores are realistic replications of those in real stores, the information transmitted to the consumer is the same and no particular difference in product and brand image evaluations is expected. However, the method of questioning has an effect on responses obtained (see for example Fiedler & Haruvy, 2009), as does interface usage, e.g. using the zoom function to investigate product or price can modify overall product and brand image evaluations. In the absence of justification for the direction of the differences, hypotheses of the absence of difference are assumed.

H1.2 There are no differences in assessments of (a) packaging, (b) product characteristics, (c) price, (d) overall assessment of a product, and (e) intention to buy.

3.1.3. Purchase rate

Purchase rate is the central behavioural indicator for the brand. Prior results appear to support an absence of differences, with a strong correlation of market share value between virtual and real stores (Burke, 1996). To understand how product characteristics and price influence the purchase rate, it is important to restrict the study to consumers who considered the product in their decision process. For this reason an additional indicator is calculated, e.g. the conversion rate, adjusting the purchase rate for product visibility. Compared with a real store, we thus assume that:

H1.3 Virtual and real lab stores provide the same results for purchase rates.

3.1.4. Habitual purchasing of the brand

For many products prior purchase of the brand has a strong effect on the purchasing process. Habitual purchasing of the brand leads to (1) better recognition of the package and (2) a higher probability of brand purchase.

In the context of an unfamiliar environment, customers will tend to rely more on internal reference points and should be less influenced by external references provided by the environment. So the differences between regular purchasers of a brand and others should be increased in the virtual environment: regular purchasers should have a more positive attitude and non-habitual purchasers a more neutral attitude. Compared with other purchasers, we thus assume that:

H1.4 Regular purchasers of the product have a higher (a) product recognition rate, (b) attitude toward the product, and (c) purchase rate.

H1.5 Differences between regular purchasers of the brand and others are higher in virtual stores than in real stores for (a) product recognition rate, (b) attitude toward the product, and (c) purchase rate.

3.2. Shopping behaviour indicators

Potential bias in purchasing activity created by virtual stores can also be observed at the behavioural level. It could influence the decision process, increasing its duration and modifying the relative importance of product attributes in choice.

3.2.1. Shopping duration

In a real store, the shopper uses heuristics and decision processes that reduce the length of a purchase decision to a very short time (less than 20 seconds and frequently less than 5 seconds) (Hoyer, 1984; Dickson & Sawyer, 1990). In a virtual environment, however, purchase duration should be longer as shoppers (1) have to abandon their routine and reformulate their approach, (2) are slowed down by the environment's novelty, and (3) could lose control and invest more time in exploration. Hence we hypothesize that:

H2.1 Shopping lasts longer in a virtual lab store when compared with a real lab store.

3.2.2. Product handling

In a real store, stimulation is multisensory; when products are picked up and handled they transmit much information (on weight, resistance, etc.). In a virtual store, manipulation is only visual and requires no physical effort; it is thus faster and easier, and the perceived cost of handling is lower, which is likely to induce greater product manipulation. In addition, exploratory behaviour and lower visibility of the products on the screen also increase the likelihood of product manipulations.

H2.2 The frequency of product handling is higher in a virtual lab store when compared with a real lab store.

3.2.3. Attention paid to price

Attention spans are limited and increased attention paid to products will be offset by less attention to other product attributes, including price. The way in which price is presented clearly influences the relative importance of price at the moment of choice. In real store a customer must make a voluntary effort to gather price information but the effort is mainly visual. In a virtual lab, the price is present on the shelf and customers can magnify this price information at will. This is close to in-store conditions but requires a physical movement and the additional effort should thus decrease price consultation. It should be noted that a reinforced presentation where the price is prominently indicated (e.g. automatically attached to the image of the product when it is clicked on) would risk overestimating price impact. Thus, we hypothesize that:

H2.3 Attention toward the price of the product will be lower in a virtual lab store than in a real lab store.

3.3. Respondents' experience

The interaction with a computer to simulate visiting a store is usually unfamiliar and thus has several consequences.

3.3.1 Understanding and perceived difficulty

In a real store consumers can easily reproduce their purchasing behaviour, but within a virtual store a specific task is requested from them. A first bias could come from the understanding of the instructions. The virtual store also requires a minimum of computer literacy (ability to manipulate the computer interface) and works best if the individual has experienced virtuality. These additional competencies will increase the perceived difficulty of the request. As a result, we formulate the following hypothesis:

H3.1 Virtual shopping is perceived to be more difficult than actual shopping in lab stores.

3.3.2 Realism

The gap between real and simulated behaviour can increase with the virtual store which is perceived as less realistic. Respondents have to translate their behaviour from the real store to the virtual store and they may give more attention to fulfilling the requested task than to strictly reproducing their natural behaviour. In a virtual store, the experience is new. The environment being unfamiliar, the respondents have to deploy a strategy of exploration. This risks distracting them from their usual shopping behaviour, but may produce acting behaviour which increases the hedonic dimension of the experience.

H3.2 The virtual experience will be perceived as (a) less realistic but (b) more enjoyable.

3.3.3. Moderating variables

Demographics such as gender and age may influence individual reactions to the computer interface.

Gender: Gender is strongly correlated with the experience of purchasing in a store and it is the experience in a store that serves as a reference to assess the experience in a laboratory. Overall, women are more often in charge of purchases for the household and additional differences can also depend on the category of product studied. For grocery products, for example, women are responsible for 78% of household food purchases in stores (Spir-Direct Panel, 2009). We therefore expect women, relative to men, to see the virtual shopping environment as less realistic. Gender has no direct effect on aptitude to manipulate a computer when other variables are taken into account (Ogletree & Williams, 1990), but gender influences the pleasure of interaction with the computer: men become more involved than women in this interaction, and specifically in video gaming (Hartmann & Klimmt, 2006).

Age: Age is correlated with a less positive perception of innovation and greater reticence in adopting innovation (Gilly & Zeithaml, 1985). Age should thus exert a negative impact on habitual and frequent use of a computer and the experience of a virtual world and its exploration.

As a result we formulate the following additional hypotheses:

H3.3 Compared with men, women will find the experience of a virtual store to be (a) less realistic and (b) less enjoyable.

H3.4 Older respondents will perceive the experience of a virtual store as more difficult.

4. Research Method

To study differences in attitudes and behaviours collected from real and virtual lab stores, the results of two independent samples are compared.

4.1. Sample

The experimental framework has two treatments (lab stores; real/virtual) with two independent samples of 160 respondents each. To isolate the specific effect of the type of laboratory, recruitment must be the same for both real and virtual lab stores. As online recruitment suffers from a selection bias (Fiedler & Haruvy, 2009), quota samples were recruited in the street based on criteria of gender (80% women), age (50% of respondents are between 18 and 34, 50% over 34), and purchasing habits (50% of habitual purchasers of the tested brand). The recruitment was carried out in four towns in the region surrounding Paris and in the south of France. Virtual store responses are weighted to reconstitute the market structure obtained with real store on the brand usually bought so that observed discrepancies cannot be explained by differences in the buying behaviour.

4.2. Experimental protocol

Following the recruitment phase, the protocol has two stages: first, the store visit and the purchases, then, second, a questionnaire by a computer assisted personal interview (CAPI).

The task required of the respondents determines the context within which they carry out the purchasing process. Instructions given to the consumers can affect all stages of the buying process, from the phase of information research to that of decision making (for an example of the process of online decision making see Darley, Blankson & Luethge, 2010). The purchasing instructions given (*carrying out shopping for five categories of product, buying the products as though shopping in your usual store*) are sufficiently clear to induce a category visit but broad enough not to induce a particular behaviour or brand choice. They are identical for real and virtual stores.

The real lab store mimics a store environment with real shelves, product, and cash register, and presents several product categories in a realistic shopping environment (light, music),

except for the absence of other customers. The virtual store is a virtual environment accessible through a computer interface with a large screen. With a shopping cart in front of him/her, the respondent moves in the virtual store using a mouse with an automatic adjustment of the sight and the size of the shelf to physical distance. With a click they can zoom independently on to product and price and 'put' the product in their cart. In both stores, at the end respondents proceed to a cashier but don't pay for their purchases.

There is a difference in store visit context: in the real store, consumers take a shopping cart and make their purchases on their own, the entire sequence being recorded by video cameras and purchases being listed as the consumers go through a fictitious checkout. In the virtual store, a researcher first explains how this works and then accompanies respondents during the virtual visit until they reach the questionnaire. The permanent presence of the researcher introduces an external perspective which can lead to bias in the virtual results by modifying behaviour, particularly when opinions of others come into play (Lewitt & List, 2007). However, this presence is justified in a virtual store to avoid a situation where the lack of expertise of certain respondents or poor understanding of instructions leads to behaviour which results in a flood of meaningless clicks (e.g. exploring the interface, or even lack of understanding of the task to be accomplished) that may be observed when an internet questionnaire is completed unsupervised.

4.3. Product

The product studied is a frequently purchased food product that costs less than 5€ (\$6.50). Questions and observations are gathered at a reference (bar-code) level.

4.4. Measurement

The independent variables were the treatment (real/virtual store) and three binary individual covariates; age (<35, =>35), gender, and regular purchase of a brand (test).

Subjective and objective dependent variables were collected based on observations and on declared behaviour (i.e. what respondents say they will do). Behavioural observations were carried out either automatically (virtual store) or through human observation (real store). Purchasing duration was measured in seconds and products bought are counted. Product handling was coded by a binary variable (yes/no).

Questions were asked subsequent to the experience of simulated shopping and according to the following sequence:

- (1) Access to price information, with four types of assessment (did not look at price, looked at unit price, looked at price per kilo, looked at unit and per kilo prices). Access to price is coded by a binary variable (no/yes).
- (2) For a specific product (test)
 - a. Measurement of visibility prompted recall: recognition of product from presentation of a board displaying a reproduction of the packaging.
 - b. Evaluations of the product measured according to the 10-point Likert scales of attractiveness: 8 items on packaging (3), perceived expensiveness (1), product (3), and overall product liking (1).
 - c. Purchasing intention for the product measured on a 5-point scale (definitely, probably, don't know, probably not, definitely not).
 - d. Assessment of the survey experience conducted on three scales: perceived realism (approximation of behaviour with that in a real shopping situation); perceived ease of the task; perceived enjoyment. Scale are based on three items each, using the 10-point Likert scales, validity is acceptable (Cronbach's alpha = 0.71, 0.76, 0.82).

5. Results

5.1. Brand indicators

5.1.1. Visibility prompted recall

Prompted product recall is lower in a virtual store than in a real store (78% compared with 85%), but the difference is not statistically significant (H1.1 is not supported). There is a very strong effect from regular purchasing of the brand ($p < .0001$) and the interaction between that variable and the store ($p = 0.001$). Regular purchasers have a better recognition of the brand (93% compared with 70%) and, notably, that visibility increases in the virtual store compared with the real store (88% to 98%), while it falls for non-habitual purchasers of the brand (82% to 58%). Therefore one important finding is that attention and concentration in the virtual store severely decrease recognition of the pack for non-habitual purchasers (see Figure 1).

< Insert Figure 1 here >

5.1.2. Product and brand image evaluations

For evaluation of packaging, product, and expensiveness, analyses are conducted by ANOVA on the mean of the items but, consistent with H1.2, no effects of lab store emerged (for packaging, $M_{\text{real}} = 6.67$, $M_{\text{virtual}} = 6.79$, for product, $M_{\text{real}} = 7.36$, $M_{\text{virtual}} = 7.04$, for expensiveness, $M_{\text{real}} = 6.71$, $M_{\text{virtual}} = 6.41$, and for overall appreciation of the product, $M_{\text{real}} = 7.22$, $M_{\text{virtual}} = 6.95$). Respondents' purchasing intent is slightly higher in the virtual store compared with the real store (42% compared with 39% say they 'certainly' aim to make the purchase), but the difference is not significant. The trial rate, defined by aggregating the levels, certainly (0.8) and probably (0.2), is not significantly different either ($p_{\text{real}} = 37\%$, $p_{\text{virtual}} = 39\%$).

< Take in Table 1 >

Although we observe no effect for store and for interaction between store and habitual purchase of the brand, habitual purchasing of the brand does increase every evaluation (pack, product, overall product, and intention to purchase) except expensiveness. For habitual purchasers, the ‘certainly’ purchase is strengthened (from 52% to 67%), while for non-habitual purchasers, purchase intentions are asserted less in acceptance and in rejection: the ‘certainly’ intention decreases from 25% to 17% and the ‘don’t know’ intention rises from 10% to 24%. This polarization is illustrated by a significant gap in the trial rate by habitual purchasers of the brand (57% compared with 47%; logistic regression, interaction effect $F=3.89$; $p = 0.048$).

5.1.2. Purchase rate

Results for each reference (bar code) are aggregated by brand and results are presented in Figure 2. At the brand level, a few major differences are observed, for example +21% for the leading brand and +116% for the store brand. Purchase rates for the virtual store are significantly different at least for two brands (C and F) (t test).

< Insert Figure 2 here >

For the tested brand, the conversion rate, defined by the purchase rate for those who have indicated that they have seen the product, is significantly higher in the virtual store than in the real store (55% compared with 41%; binary logistic regression, $\text{Chi}^2 \text{ Wald} = 4.64$; $p = 0.031$; H1.3 is supported).

Regular purchase of the brand has a significant direct effect ($p < .0001$) and marginally significant interaction effect ($p = 0.076$) on purchase rate (see Figure 3). Among habitual brand buyers, purchase rate increases from 57% in a real store to 74% in a virtual store. Among non-habitual buyers, purchase rate decreases from 14% in a real store to 11% in a virtual store.

< Insert Figure 3 here >

5.2. Behavioural indicators

In terms of behaviour when visiting a store, differences between virtual and real store are very marked. Shopping duration is analysed by ANOVA with interactions for two independent variables (age and gender). Binary dependent variables are analysed with logistic regression (Table 2).

Shopping lasts longer in a virtual lab store ($M_{\text{real}} = 15$ seconds, $M_{\text{virtual}} = 35$ seconds; H2.1 is supported). Age has a direct positive effect only on duration of purchase. The rate of product handling is significantly higher in the virtual store (24% compared with 14%; H2.2 is supported). The increased attention paid to products may be obtained at the expense of information on price, as attention paid to price is significantly lower in a virtual store (only 9% of respondents looked at price in a virtual store compared with 39% in a real store; $\text{Chi}^2=5.02$; $p = .025$; H2.3 is supported). Gender and age have no effect on attention to price.

< Take in Table 2 >

5.3. Respondents' experience

Data are presented in Appendix 1 and analysed by t tests and ANOVA with store, age, and gender as independent variables and interaction (Table 3).

The task required in the virtual laboratory store is perceived as significantly less interesting by the respondents. It is less easy (more difficult) than that required in the real store ($M_{\text{real}} = 7.62$ vs. $M_{\text{virtual}} = 6.11$; $p < .0001$; H3.1 is supported). The same results are observed for realism and enjoyment, with a significant effect for store variable, significant direct effect and interaction for gender, but no significant effect for age. Realism is 25% lower ($M_{\text{real}} = 7.60$ vs.

$M_{\text{virtual}} = 5.66$; $p < .0001$) and enjoyment is 17% lower ($M_{\text{real}} = 6.79$ vs. $M_{\text{virtual}} = 5.59$; $p < .0001$; H3.2 is partially supported as hypothesis on enjoyment is reversed).

The effect of store variable on respondent experience is moderated by gender for the three variables: women find the real store experience easier, more fun, and more realistic than men, but the results are the opposite for the virtual store: men's evaluations of the experience are not significantly different except for a decrease in realism ($p = 0.02$), but evaluations of the experience are significantly reduced for women (H3.3 supported). Age has only a marginal effect on realism and enjoyment, but has a direct positive effect and an interaction effect on perceived difficulty: older people perceived the task in the virtual lab store as being more difficult (H3.4 supported).

< Take in Table 3 >

In conclusion, the analysis demonstrates that at a segment level (regular purchasers of the brand versus others), using virtual lab stores produces significantly different conclusions: regular purchasers of the product have a higher (a) product recognition rate, (b) purchase rate, (c) conversion rate, and a better evaluation of product and pack, but not for price. A significant interaction effect also exists for product recognition and a marginally significant interaction effect for purchase rate: regular purchasers of the brand have a greater tendency to buy the product that they know and to enhance their assessment, while other shoppers reduce their likelihood of trying the product and downgrade their evaluations. This conclusion has important implications for the choice of test and the importance of bias according to the main target.

6. Discussion

6.1. Summary of contribution

The virtual lab store is a new methodology in the toolkit of research techniques used to test a marketing decision, whether at the level of product or package innovation or that of merchandising and promotional choice.

The virtual store presents real advantages in terms of implementation, experimental control, and confidentiality. It enables testing of new products at earlier stages without involving physical production of the options. However, the addition of the computer interface for the shopping makes the task demanded of the consumer less realistic, at least for products which are not yet predominantly bought on the internet. It is thus important to understand the biases created by this addition by comparing, for different types of attitudinal and behavioural measurements, the results of a virtual lab store with those of a real lab store – and this is a methodology where experience is much more important.

First, the study confirms that the methodology is not neutral and that the virtual store leads to less natural purchasing behaviour, resulting from difficulties in understanding instructions and management of the interface. This leads to a marked increase in the length of the act of purchase, notably for older people and marginally for women. It is thus important to take account of this bias in the categories of products that are targeted particularly towards these consumers.

Appreciably different results are also observed for other measurements. Product recall declines: even if respondents are more likely to handle some products, they are less likely to remember having seen others. This overall drop in recall results from an interaction effect with the regular purchase of the brand, and so in a virtual store customers are probably more likely to spot products that they already know.

This interaction between purchasing behaviour and previous experience of the brand explains (1) a downturn observed in purchase intentions, which are greater for regular purchasers of the brand, and greater uncertainty for non-habitual purchasers, and (2) a marginally higher purchase rate for regular buyers. In the end, the projected trial of regular purchasers is 20% higher in a virtual store compared with that measured in a real store.

This gap between targets as regards purchasing levels should encourage prudence in the interpretation of results when modifications are made to the marketing mix. Behavioural measurements provide important results showing that the virtual store modifies measures asymmetrically: it increases the effects for regular purchasers versus a reduction in effects for other purchasers. The decision-making process of the shopper in a store is strongly influenced by the test protocol, with longer purchase durations favouring rationality.

The difference between the recall measurements underscores the difficulties of accurate measurement of the behavioural impact of a pack on the shelves illustrated by an on-screen presentation without the real sensory experience of movement in shopping. This acknowledgement invites prudence in the case of studies destined to validate the impact of a marketing or packaging plan for the shelves. The same goes for price studies when external validity is challenged by the scale of effects that are notably linked to attention. Attention paid to price is far less in a virtual store. Fewer than 10% of consumers looked at the price compared with 40% in the real store. The purchasing decision is thus significantly altered.

On the other hand, the average results at the brand level obtained from responses to questions on attitude do not appear to be influenced by type of store. The virtual store gives identical results to the real store in assessment of the product and pack tested. However, this absence of effect masks an interaction with regular purchase of the brand, regular purchasers being more likely to notice their product in the virtual shop.

These conclusions echo those of the pioneering study conducted by Burke et al. (1992), which emphasized that the results from virtual laboratory stores were biased, notably by previous experience, and that it was necessary to ensure that the significant variables for in-store purchasing of the category of product tested were presented with the same quality in a virtual store. Measurements taken in a virtual store thus do not seem to be easily converted to replicate the results obtained in a real test store, and it will be necessary to study the specific contribution of these new methods to the different stages of the development process.

6.2. Implications for managers

These results enable clarification of the choice of methodologies depending on the decision context and on buying behaviour.

The major advantage of a laboratory store lies in its capacity to put a marketing proposal back into a competitive context, so enabling a relative evaluation that is closer to reality than the absolute assessment, divorced from competition, provided by a concept board. Both data collection environments (real vs. virtual) are certainly not fully substitutable, but could offer complementary benefits depending on the development stage of the marketing decision (early or final), and type and level of accuracy of measure required (attitudinal or behavioural). The virtual store provides attitudinal but not behavioural evaluations that are comparable to those obtained in a real store.

If the expected marketing decision is mainly driven by attitudinal and rational factors on the shopper side (to screen a new concept or packaging option at an early stage with measures like fit to brand, image items, likeability, etc.), a virtual solution can be recommended vs. alternatives where the product is tested on its own, as it is always better to take into account the competitive environment in evaluation (and both virtual and real environments do). This opens opportunities for the use of virtual solutions at an early stage of pack and new product

development when marketing budgets require limited investments: a virtual store enables the representation of several options with greater realism, at relatively low cost, while still at the ideation stage.

However, if the decision to be made is at the end of the development process (for example, to calculate purchase forecast, to measure shelf impact, to decide launch or pricing), and shopper behaviour and the physical environment (in particular heavy buyers contribution) plays a major role in key marketing performance indicators, then the real environment should certainly be recommended rather than the virtual.

The virtual store environment (with navigation) leads habitual brand shoppers to replicate past purchasing processes, based on automatic functioning, and their memories activate an evaluation 'jogger'. In this way, this environment enhances the pertinence of information gathered during research into purchasing and consumption of existing products, well before marketing decisions are made (e.g. studies of use and attitudes, brakes and barriers to purchase). In a quantitative approach, the virtual store substitutes for declarative studies based on the memory of the respondent. It can thus also be integrated in a qualitative exploratory approach as an element of stimulation of a purchasing experience in a store.

The results of this study lead us to recommend the methodology of the virtual laboratory store in decision contexts where the target and purchasing process lead to lesser bias. It is a case then of recommending it for younger targets or for categories of products that are the object of a purchase that is primarily rational, by reason, for example, of a lower purchasing frequency (e.g. car accessories) or greater involvement of the purchaser (e.g. health products or white goods), or for which the plethora of products or purchasing habits do not lead to heuristic decision making or even unconscious processes. In addition to other constraints, notably linked to the absence of multisensory stimulation (touch, smell, etc.), we must also

warn against recommending the use of virtual stores when the senses are strongly mobilized in the purchase decision (e.g. meat, shower gel, fabrics, smartphones).

6.3. Directions for future research

Several factors can limit the validity of the results obtained and they correspond to as many research directions.

A first limitation concerns the stimuli used: this study focuses only on products that exist in the market. The results cannot thus be extrapolated to suggest the effect of a new stimulus to change behaviour. Another limitation relates to the lack of account taken of promotions in this study. For categories of products for which the purchasing decision takes place in a store, in-store promotional communication is very important (Inman et al., 2009) and taking promotions into account is a potential avenue for further research.

Taking into account the potential and rapid development of computer simulation technologies, virtual laboratories will become an integral part of the range of marketing research tools for the FMCG sector. Reticence vis-à-vis the internet and internet gaming probably explains the greater difficulties experienced by older people and, to a lesser degree, women. With the maturity of the generations who have played electronic games and improvement in the quality of the interface, barriers to reaching these target customers will diminish. Growing use of computers and of internet shopping will also reduce the bias created by the interface, and another possible route for further research would involve determining whether results comparing different types of laboratory stores vary when recruitment of shoppers takes into account previous online shopping experiences.

Finally, future research should also address two sources of 'non-rational' buying behaviour. The first source is a limited, but still rational, cognitive decision process which can be used under either time pressure or limited resource availability: what is the information

collected and how is it used in the decision process? The second source has to do with a non-cognitive process involved at an early stage (sensory information) or with emotions which can influence the cognitive decision process.

Figure 1: Visibility prompted recall by store and habitual purchase of the brand

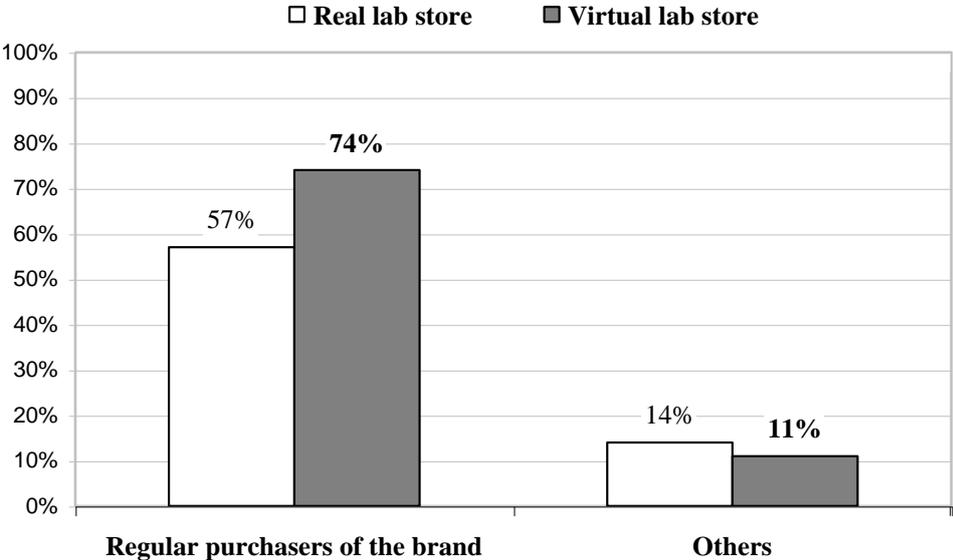
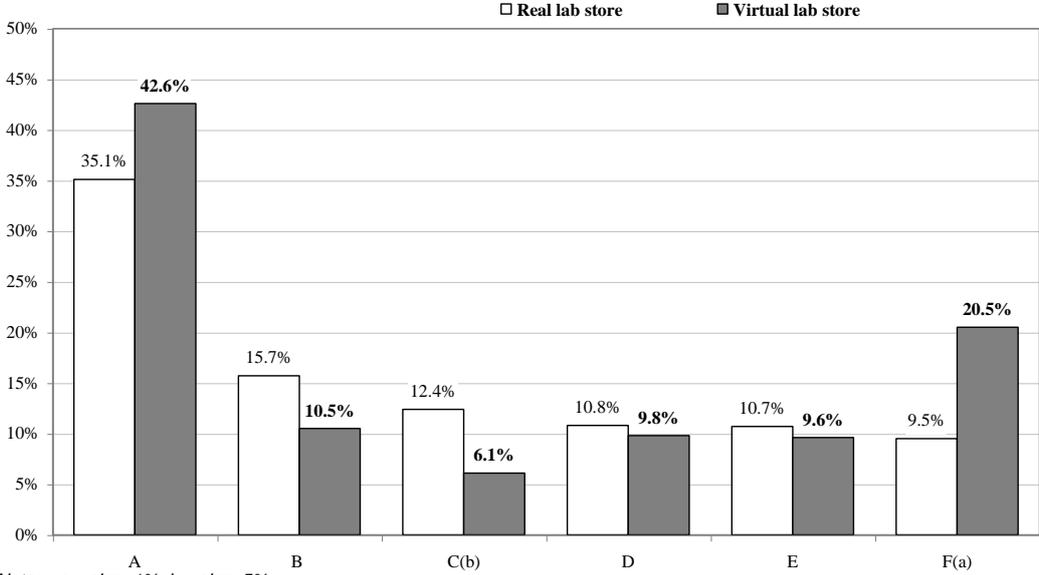


Figure 2: Purchase rate by brand and lab store



Notes : a = sign. 1%; b = sign. 5%

Figure 3: Purchase rate for a brand (test) by store and habitual purchase of the brand

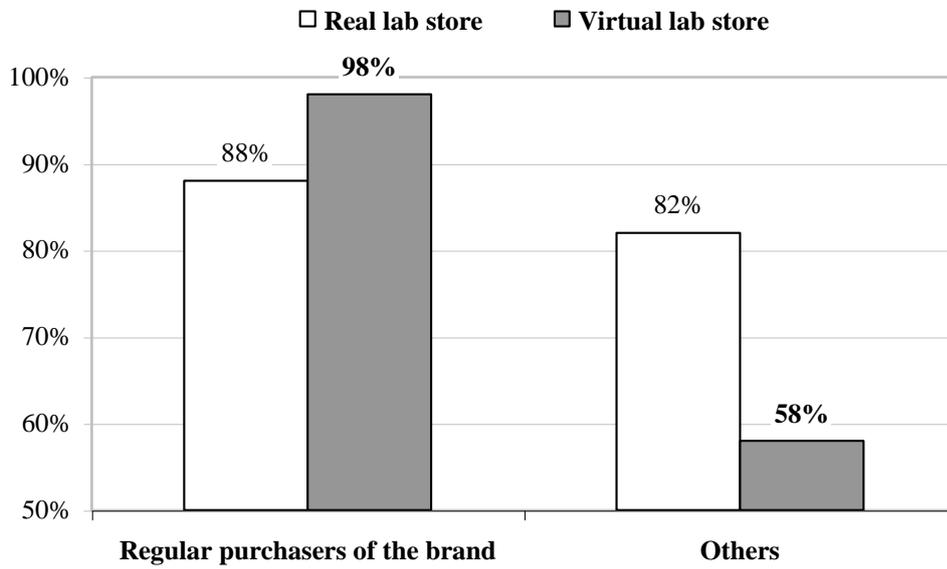


Figure 4: Respondent's experience by store and gender (men and women)

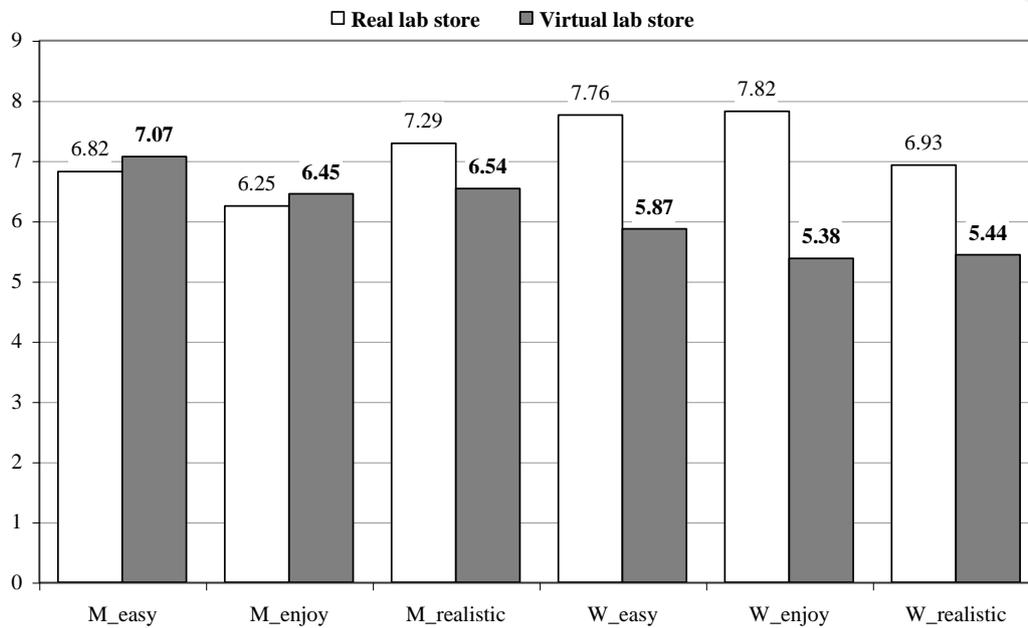


Table 1: Brand level indicators in real and virtual lab stores (ANOVA)

				Store	Gender	Age	H_Purchaser*	Store x Gender	Store x Age	Store x H_Purchaser
Pack	F	3.56	estimate	-0.967	-0.304	-0.736 ^a	0.947 ^b	1.081 ^b	0.407	-0.446
	<i>p</i>	<i>0.001</i>	<i>t-value</i>	<i>-1.58</i>	<i>-0.78</i>	<i>-2.35</i>	<i>3.02</i>	<i>1.96</i>	<i>0.92</i>	<i>-1.01</i>
Product	F	4.18	estimate	0.123	-0.126	-0.251	0.97 ^a	0.798 ^c	-0.198	-0.682 ^c
	<i>p</i>	<i>0.00</i>	<i>t-value</i>	<i>0.25</i>	<i>-0.40</i>	<i>-0.99</i>	<i>3.83</i>	<i>1.79</i>	<i>-0.51</i>	<i>-1.90</i>
Price	F	3.46	estimate	-0.588	-0.359	-1.179 ^a	0.291	0.933 ^c	0.601	-0.325
	<i>p</i>	<i>0.001</i>	<i>t-value</i>	<i>-0.97</i>	<i>-0.93</i>	<i>-3.82</i>	<i>0.94</i>	<i>1.71</i>	<i>1.37</i>	<i>-0.74</i>
Overall product	F	6.39	estimate	0.129	-0.083	-0.625	1.505 ^a	0.372	0.037	-0.355
	<i>p</i>	<i><.0001</i>	<i>t-value</i>	<i>0.20</i>	<i>-0.20</i>	<i>-1.88</i>	<i>4.52</i>	<i>0.63</i>	<i>0.08</i>	<i>-0.75</i>
Intention to purchase	F	6.39	estimate	0.226	0.235	0.112	-0.973 ^a	-0.108	-0.173	0.276
	<i>p</i>	<i><.0001</i>	<i>t-value</i>	<i>0.64</i>	<i>1.04</i>	<i>0.62</i>	<i>-5.38</i>	<i>-0.34</i>	<i>-0.68</i>	<i>1.08</i>

Notes ^a Indicates that the relationship is significant at 0.01 alpha level

^b Indicates that the relationship is significant at 0.05 alpha level

^c Indicates that the relationship is significant at 0.10 alpha level

* Habitual purchaser of the brand

Table 2: Behavioural indicators in real and virtual lab stores (binary logistic regression)

				Store	Gender	Age	H_Purchaser*	Store x Gender	Store x Age	Store x H_Purchaser
Product handling	Chi2 wald	6.78	estimate	-0.292	0.219	-0.02	0.049	-0.051	-0.101	0.007
	p <.0001		<i>Chi2 Wald</i>	<i>2.15</i>	<i>1.20</i>	<i>0.01</i>	<i>0.11</i>	<i>0.06</i>	<i>0.46</i>	<i>0.00</i>
Product visibility	Chi2 wald	34.19	estimate	-0.014	0.264	0.045	-1.066 ^a	-0.034	0.066	0.784 ^a
	p <.0001		<i>Chi2 Wald</i>	<i>0</i>	<i>0.38</i>	<i>0.65</i>	<i>18.33</i>	<i>0.00</i>	<i>1.40</i>	<i>9.92</i>
Attention to price	Chi2 wald	34.92	estimate	-1.219 ^a	-0.182	-0.293 ^c	-0.091	0.341	0.134	0.186
	p <.0001		<i>Chi2 Wald</i>	<i>21.77</i>	<i>0.52</i>	<i>2.93</i>	<i>0.29</i>	<i>1.82</i>	<i>0.61</i>	<i>1.24</i>
Notes	^a Indicates that the relationship is significant at 0.01 alpha level ^b Indicates that the relationship is significant at 0.05 alpha level ^c Indicates that the relationship is significant at 0.10 alpha level			* Habitual purchaser of the brand						

Table 3: Respondent experience and behaviour in real and virtual lab stores (ANOVA)

	F		Store	Gender	Age	Store x Gender	Store x Age
Enjoyement	F 7.85	estimate	0.27	-0.985 ^b	0.794 ^b	1.663 ^a	-0.803 ^c
	<i>p</i> <.0001	<i>t-value</i>	0.46	-2.32	2.33	2.77	-1.67
Easy	F 14.77	estimate	0.256	-1.111 ^a	0.881 ^a	2.108 ^a	-0.892 ^a
	<i>p</i> <.0001	<i>t-value</i>	0.5	-2.91	2.88	3.90	-2.07
Realistic	F 13.12	estimate	1.169	-1.041 ^a	0.578 ^c	1.498 ^b	-0.753
	<i>p</i> <.0001	<i>t-value</i>	1.98	-2.66	1.85	2.48	-1.41
Purchase time	F 8.11	estimate	-26.43 ^a	0.62	-13.61 ^a	1.53	10.41
	<i>p</i> <.0001	<i>t-value</i>	-3.06	0.10	-2.74	0.17	1.48

Notes

- ^a Indicates that the relationship is significant at 0.01 alpha level
- ^b Indicates that the relationship is significant at 0.05 alpha level
- ^c Indicates that the relationship is significant at 0.10 alpha level

Appendix 1

	Store		Purchaser		Store x Purchaser			
	Real	Virtual	Regular	Others	Real		Virtual	
					Regular	Other	Regular	Other
Participants	160	160	160	160	80	80	80	80
EVALUATIONS (/10)								
Pack item 1	6.78	6.86	7.23	6.41	7.06	6.50	7.40	6.32
Pack item 2	6.49	6.57	6.86	6.2	6.64	6.34	7.08	6.06
Pack item 3	6.74	6.94	7.26	6.42	7.06	6.41	7.45	6.43
Pack (mean)	6.67	6.79	7.11	6.34	6.92	6.41	7.31	6.27
Product item 1	7.45	7.25	7.64	7.06	7.52	7.38	7.76	6.74
Product item 2	7.33	6.93	7.43	6.83	7.47	7.19	7.39	6.47
Product item 3	7.30	6.95	7.52	6.73	7.55	7.05	7.49	6.41
Product (mean)	7.36	7.04	7.53	6.87	7.51	7.21	7.54	6.54
Expensiveness item 1	6.71	6.41	6.67	6.45	6.72	6.71	6.63	6.20
Overall appreciation item 1	7.22	6.95	7.78	6.39	7.82	6.61	7.73	6.16
PURCHASE INTENTION (/5) certainly = 1	2.20	2.01	1.68	2.53	1.85	2.55	1.51	2.51
BRAND LEVEL								
Product recall	84.85%	77.90%	93.09%	69.67%	87.92%	81.79%	98.26%	57.55%
Purchase	35.06%	42.62%	65.51%	12.18%	56.55%	13.58%	74.46%	10.79%
Conversion	41.32%	54.72%	70.37%	17.49%	64.32%	16.60%	75.78%	18.75%
Trial	37.03%	39.34%	51.95%	24.42%	46.86%	27.21%	57.04%	21.63%
BEHAVIOURS								
Purchase time (seconds)	14.79	34.78	23.97	24.60	16.98	12.60	30.96	38.61
Handling	14.30%	24.18%	19.75%	18.74%	15.10%	13.51%	24.4%	23.96%
Attention paid to price	39.02%	8.76%	23.38%	24.40%	36.48%	41.55%	10.27%	7.24%
	Real	Virtual	Habitual	Non	Real	Virtual	Real	Virtual
EXPERIENCE (/10)								
Easy item 1	7.89	7.47	7.68	7.69	8.03	7.75	7.33	7.62
Easy item 2	7.39	5.53	6.25	6.67	7.25	7.53	5.25	5.80
Easy item 3	7.58	5.34	6.16	6.76	7.31	7.85	5.02	5.66
Easy (mean)	7.62	6.11	6.7	7.04	7.53	7.71	5.87	6.36
Realistic item 1	7.47	5.13	6.39	6.21	7.71	7.23	5.08	5.18
Realistic item 2	8.25	7.47	7.91	7.56	8.22	8.28	7.74	7.20
Realistic item 3	6.88	4.39	5.19	5.31	6.96	6.79	4.19	4.58
Realistic (mean)	7.60	5.66	6.41	6.25	7.74	7.45	5.67	5.66
Enjoyableness item 1	6.93	6.10	6.49	6.54	7.11	6.74	5.86	6.35
Enjoyableness item 2	6.53	5.48	5.76	6.24	6.56	6.49	4.96	5.99
Enjoyableness item 3	6.93	5.21	5.87	6.27	6.96	6.91	4.79	5.63
Enjoyableness (mean)	6.80	5.60	6.04	6.35	6.88	6.71	5.20	5.99

Mis en forme

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