Deviations from Matching in Consumer Choice

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Previous research has demonstrated that the matching law can be successfully applied to consumers' patterns of choice with substitutable products at both individual and aggregated (across a number of individuals) levels of analysis. This research aimed to clarify and generalize previous results found at an individual level using independent and complementary products. Aggregated results show that consumers behave according to the predictions of the matching law with qualitatively different reinforcers only when the data are considered on a weekly basis, i.e., as determined by a series of analogic FR schedules. For analogic VR schedules consumers showed matching independently of the degree of substitutability between the products. Further research is needed at an individual level for which the results were not conclusive, and with more extreme forms of complementarity between products.

Key words: matching theory, consumer behavior, behavioral economics, substitutability, antimatching.

Consumer researchers have established that most buyers of fast-moving consumer goods such as packaged foods practice multi-brand purchasing. Analyses of such products show that most consumers tend to purchase a variety of brands within a product category, selecting among a small "repertoire" of brands rather than being exclusively loyal to a single brand (Ehrenberg, 1988). Research generally shows that in stationary conditions (i.e., the absence of any marked short-term trend in sales) only a few consumers acquire a given brand on consecutive shopping occasions; (b) most consumers buy several different brands, selecting them apparently randomly from a subset or 'repertoire' of known, tried and tested brands. At the brand level, (c) each brand attracts only a small percentage of 100%-loyal consumers; (d) brands within a product category tend to differ broadly with respect to their penetration levels but tend to be more similar in terms of their average purchasing frequency; and (e) brands with smaller penetration levels (or market shares) also tend to show smaller average buying frequencies and smaller percentages of 100%-loyal consumers (i.e., the effect known as "Double Jeopardy"). These patterns have been demonstrated for a variety of product categories, from food and drinks to aviation fuel, from personal care products to pharmaceutical prescriptions, for patterns of shopping trips and selection of store chains (Ehrenberg, 1988; Goodhardt, Ehrenberg & Chatfield, 1984; Uncles, Ehrenberg, & Hammond, 1995).

Based on these results, a mathematical model was developed which makes it possible to describe the patterns found, the Dirichlet Model (Goodhardt et al., 1984). It focuses on the differences

between brands' penetration as explanatory variable, and it has been satisfactorily used to analyze the effects of promotions (Ehrenberg, Hammond, & Goodhardt, 1994), to evaluate patterns of store loyalty (Uncles & Ehrenberg, 1990), and to predict the insertion of new products into the market (Ehrenberg, 1993). However, as the model's authors conclude, the Dirichlet says little about the variables that account for individuals' patterns of behavior (Goodhardt et al., 1984).

Marketing research has sometimes tended to overlook the effect of price by emphasizing the non-price elements of the marketing mix, concentrating especially on promotional activities (e.g., advertising) that make for brand differentiation. Therefore, price has rarely been used in marketing to systematically explain brand choices other than in the context of promotional campaigns which generally constitute tactical exceptions of marketing strategies (Ehrenberg et al., 1994). However, price is a frequent source of explanation in behavioral economic research, where the economic behavior of animals in experimental conditions has been widely explored, and where price has been seen as the sole index of the varied influences on consumer demand brought about by the marketing system. In this sense, behavioral economists have followed the reasoning and methodology of economics rather than those used by marketing sciences.

Rational choice theory would suggest that consumers would choose the option with the highest utility. In other words, rational choice theory would assume that consumers would purchase just one brand, i.e. they would do the best thing possible under all circumstances. However, as has already been seen, consumers do not tend to act in this way and instead make multibrand purchases. Operant psychology makes predictions based on observed patterns of behavior controlled by a history of reinforcement, not the foresight expected in economically rational choices (Lea 1978). In 1990, Herrnstein suggested an alternative theory of choice, the matching law. He stated that although rational choice theory remains unequaled as a normative theory, deviations from it are generally well explained by the matching law, including the issue of non 100% loyalty to a particular choice.

The matching law was developed by behavioral scientists based on the results obtained in choice experiments with non-human subjects. Within the matching law, choice is defined not as an internal deliberative process, but as a rate of temporally distributed intersubjectively observable events (Herrnstein, 1997). In its simplest form, the matching law establishes that, when presented with a choice situation (two opportunities to respond X and Y) organisms allocate their responses according to the rates of rewards available in each alternative (Herrnstein, 1961, 1970). In other words, the response rate (B) is proportional to the relative rate of reinforcement (R) (De Villiers & Herrnstein, 1976). In this sense, the matching relation takes the form:

$$B_x/(B_x+B_y)=R_x/(R_x+R_y) \quad (1)$$

Where B is the number of responses allocated to options x and y and R is the number of reinforcements contingent upon those responses. Expressed in terms of ratios this relation becomes:

$$B_x/B_y=R_x/R_y \quad (2)$$

A generalized form of the matching law states that the ratio of responses between two alternatives is a power function of the ratio of reinforcements (Baum, 1974 see also Baum, 1979). Expressed in arithmetic terms this relation becomes:

$$(\log)B_x/B_y = s\ (\log)(R_x/R_y) + (\log)b \quad (3)$$

In the generalized matching law, the constants b and s account respectively for the differences among reinforcers in terms of *bias* (e.g., preferences for one reinforcer based on features such as physical placement or color), and *sensitivity* (e.g. responsiveness to the alternative responses) (Baum, 1974). The parameter log b or *bias* constitutes the intercept of the linear log-log formulation of the law. Deviations of this parameter from unity are interpreted as indicating a consistent preference for one option independently of its reinforcement rate schedule. Such bias is generally a result of experimental artifacts that could make one response less costly than the other.

The exponent s constitutes the slope of the linear log-log formulation, and corresponds to a deviation from strict matching, indicating that the individual favors the richer (s>1, overmatching) or the poorer (s<1, undermatching) schedule of reinforcement more than predicted by the matching law (see Baum, 1974). Furthermore, research us-

ing matching analysis with qualitatively different reinforcers (e.g. food and water) has shown to be an exception to the predictions of matching law. When using qualitatively different commodities, as gross complements (i.e. when an increase on the consumption of one product requires the increase of the consumption of a second product, as is the case with food and water), it has been found that choice ratio has an inverse relationship with the reinforcement ratio, showing the exact opposite to what the matching law predicts (Hursh, 1978; see Kagel, Battalio, & Green, 1995 for a review). Hence, this particular effect has been named *Anti-matching,* and in operational terms it consists of a result of s<0 in the generalized matching equation (Kagel et al., 1995).

Similar results (see Kagel, et al., 1995 for a review) have allowed behavioral economists to conclude that the parameters on the generalized matching equation could be assumed to be an analogous measure of the economic principle of substitutability of reinforcements in the experimental situation (Foxall, 1999; Green & Freed, 1993; Rachlin, Battalio, Kagel, & Green, 1981). The concept of substitutability is referred to as a continuum of possible interactions among reinforcers (Green & Freed, 1993). One end of that continuum is defined by perfectly substitutable commodities, the other by complementary products, and independent products correspond to the middle point between the two. Green and Freed (1993) point out that a definition of substitutability has to consider not only qualitative similarities between the reinforcers, but also their function. In this sense, these authors define substitutable goods as "those that serve similar purposes" (p. 142). Therefore, by definition, commodities that serve different purposes are considered as either complements (in the case that they are used jointly, i.e., tea and biscuits) or independent goods (i.e., tea and baked beans).

Matching and other operant techniques, developed and widely tested and replicated in experimental settings (generally with rats and pigeons) have been used in a wide range of human and more applied situations. Token economies have been used extensively to test operant principles and the similarities between operant and economic predictions (see for example: Ayllon & Azrin, 1968, Kagel 1972; Kagel, Battalio, Rachlin, Green, Basmann, & Klemm 1975). Other relevant studies include those by Conger and Kileen (1974) who used time allocation matching to investigate human social processes and found close approximations to matching, Berrnstein and Ebbesen (1978) who examined how people allocate their time between different activities, Buskist and Miller (1981) who used a vending machine to explore VI-VI schedules and Myerson and Hale (1984) who used VI schedules to reduce inappropriate behavior. Within consumer psychology there have been a number of attempts to apply operant techniques, behavioral ecology and matching. These include studies by Hantula and colleagues using simulated malls (e.g. Rajala & Hantula 2000, Smith & Hantula 2003).

The molar analysis of behavior provided by the matching law (response frequencies as a function of reinforcement frequencies instead of a molecular stimulus-response analysis) has given a framework for behavior analysts to investigate multi-brand patterns of consumption. The first theoretical attempt to apply matching and melioration to consumer choice was Foxall (1999) who suggests that, in terms of purchasing, the matching law would state that 'the proportion of dollars/pounds spent for a commodity will match the proportion of reinforcers earned (i.e. purchases made as a result of that spending). He also suggests that although matching was developed on and largely tested with VI[1] schedules, ratio schedules[2] may be more suitable to explain consumption/purchase situations. There is general agreement in the literature regarding this (see Hursh 1984; Hursh & Bauman 1987; Myerson & Hale 1984). It is supported by the idea that, to obtain a product, individuals must provide a certain number of responses, for example, 33 to purchase a tin of baked beans (a tin of baked beans would cost 33 pence/cents). Although there has

[1] An interval schedule maintains a constant minimum time interval between rewards (or reinforcements). Fixed interval (FI) schedules maintain a constant period of time between intervals, while a variable interval schedule (VI) the time varies between one reinforcers and the next.

[2] A ratio schedule is one in which a specified number of responses have to be preformed before reinforcement becomes available. Fixed Ratio (FR) schedules keep the number of required responses equal from one reinforcer to the next; variable ratio (VR) schedules allow the required number of responses to change from one reinforcer to the next.

been a debate over whether FR or VR schedules are a more suitable analogue, it is the proposition of this research that FR schedules represent a consumer's choice in a one week period (the prices are fixed within the shopping trip) while VR schedules represent an aggregation across shopping trips (as prices will vary between weeks) and hence the terms VR3 (across 3 weeks) and VR5 (across 5 weeks) have been used to describe particular integrations of the data in ways analogous to the schedules employed in the experimental analysis of behavior (Foxall and James, 2001). The 1-week ("FR") and 3-week ("VR3") time scales were chosen simply to provide enough data within the 16 week period of available information. They also seem to be different enough to produce noticeable effect across the weeks. The matching law suggests that both concurrent VR-VR and concurrent FR-FR schedules would result in the same behavior patterns: i.e., exclusive preference on the best schedule.

The first quantitative attempt to apply the matching law to the analysis of brand and product choice in real-world conditions was done by Foxall and James (2001, 2003). This preliminary research sought to establish whether 1) matching (the methodology employed will be discussed further later), 2) maximization and 3) downward-sloping demand curves were found in consumers' shopping behavior. The research was undertaken in two phases, a qualitative and a quantitative phase. The qualitative phase allowed the researchers to obtain information about general shopping and purchasing habits of subjects recruited on a convenience basis, and it was particularly important for understanding the degree of substitutability-in-use of different brands of the same product category.

The quantitative phase gave information about the occurrence or non-occurrence of the matching phenomenon at different levels of substitutability through the analysis of prices paid and amount bought. The investigation focused on single subjects' shopping patterns of specific products categories selected from the results of the qualitative research. The purchase choice of substitutes (different brands of cat food), non-substitutes (bottled soft drinks in another) and independent (wine and cola) products were analyzed for 1 (FR)-, 3 (VR3)-, and 5 (VR5)- week periods. The results of this preliminary research showed how consumer choices at product and brand levels could be analyzed using the matching, relative demand analysis and maximization theories and provided evidence of the importance of price on consumer decision making.

Foxall and James (2001, 2003) found near perfect matching, maximization, and very strong downward sloping demand curves for substitutable products. The qualitative analysis supported these results, since the participants explained how they alternated their choices among the different brands of their repertoire of brands, deciding from week to week based on price dealings or seeking to achieve variety. Similar analyses were performed with brands that were not substantially substitutes. A subject bought two brands of cola on a weekly basis, and he described them as non-substitutes. The results were similar to those found for substitutable products, showing again almost near matching and maximization. The demand curves, however, showed less negative slopes (some were even positive) which is coherent with inelastic demand. Following the conclusions of Kagel et al. (1995) antimatching was expected for grossly complementary products. The results for the maximization and relative demand analyses did not differ substantially from those found for substitutable and non-substitutable brands, but they did differ for the matching analysis. Of particular interest for the present paper, the results for substitutable brands compared to gross-complements yielded different levels of sensitivity, showing generally the theoretically expected behavior. For commodities that were considered perfect substitutes and independents the results showed an s close to 1 on the logarithmic expression of the matching curve, whereas for grossly complementary products antimatching was observed, but only for the 3-week VR schedule. For the other two analyses, undermatching was found, showing a clear need for further analysis.

Similar analyses were undertaken by Foxall and Schrezenmaier (2003) and Foxall et al. (2004) whose research sought to generalize the results found by Foxall and James (2001) on perfect substitutes (different brands of the same product category) by using a sample of 80 consumers, buy-

ing nine food product categories over 16 weeks. In this study, the researchers did not approach the participants directly, but used data provided by a consumer panel from a set of randomly selected British households. Following the procedure used by Foxall and James (2001), matching, maximization analysis, and the relative demand curve were carried out on FR (1 week) and VR (3 weeks) schedules, based on an aggregated analysis across consumers and also weeks, in the case of the VR3 schedule.

Foxall and Schrezenmaier (2003) analyzed patterns of choice for different brands within the same product category. In accordance with Ehrenberg (1988), multi-brand choice patterns were found for the majority of the sample among the different product categories, and only a small number of consumers showed sole buying choices of each brand. Likewise, matching was found and in accordance to the generalized matching law stated by Baum (1974) the parameter *s* indicated substitutability among the different brands within the consumers' repertoire. For the relative demand analysis, the expected downward sloping curves were found. Maximization analysis showed a more complicated pattern, since consumers mostly bought the cheapest brand within their repertoire of brands, which was however not necessarily the cheapest among all the brands of the product category. In other words, their repertoire in some cases included only premium, highly differentiated brands, and these consumers bought the cheapest brand within those exclusive repertoires, therefore maximizing in terms on their own consideration set and not in any "absolute" sense.

Foxall el al. (2004) conducted further analyses in order to understand this pattern of maximization in which consumers buy the cheapest brand within their own repertoire of brands instead of the cheapest brand among all the brands available within a product category. In other words, they aimed to investigate why different brands of the same product (that are supposed to be functionally equivalent) are not always perceived by consumers as perfect substitutes for each other. This research constitutes a deeper attempt to integrate behavioral economic theories with the postulates of marketing sciences, since it managed to include ideas of branding (as an extra-functional source of reinforcement) within economic (price-focused) proposals through the differentiation between utilitarian (functional benefits derived from purchase and consumption) and informational (symbolic, usually mediated by actions and reactions of other persons) reinforcements proposed by the Behavioral Perspective Model (Foxall, 1990, 1996). The results suggested that consumers choose their set of brands within a product category based on both utilitarian and informational levels of reinforcement programmed by the brands. The authors concluded that consumers could be segmented (grouped) through their choices by the combinations provided by this categorization.

However, the analysis performed by Foxall et al. (2004) was carried out only at the brand level, where near perfect matching was expected, and the somewhat inconclusive results found by Foxall and James (2001) and Foxall and James (2003) on antimatching warranted further analysis. The current research further investigates matching patterns in consumer choice with different product categories among which different levels of substitutability are expected. It employs the same data employed by Foxall et al. (2004). The general expectation guiding the research was that, for more substitutable products, some degree of matching would be apparent, whereas complementary products would exhibit antimatching.

Method

Sample

Participants were 80 British consumers selected from the Taylor Nelson Sofres "Superpanel", which comprises some 15,000 households that represent the British population. The Superpanel collects data on all purchases for each of the 15,000 households as and when they shop. Panel members scan the barcode printed on the packaging of their purchases into a sophisticated handheld barcode reader after each shopping occasion. The information recorded for each shopping occasion includes selected brand, actual price paid, quantity bought (package sizes), number of units bought, date, and name of the supermarket/shop. The data are then electronically transmitted to the TNS mainframe computer, and can be used

to generate market trends reports. The 80 consumers used in this study were chosen randomly. The data obtained corresponds to 9 fast-moving consumer product categories during a period of 16 weeks from the 25th February 2001 to 10th June 2001. The categories used in this research were: tea, instant coffee, butter, margarine, fruit juice, breakfast cereals, baked beans, and biscuits (cookies).

Procedure

Based on the 9 product categories available, 10 combinations of products were created varying in their level of substitutability. In this sense, a combination of cereals/margarine was expected to exhibit greater mutual independence than the combination biscuits/tea and biscuits/coffee which consumers are more likely to perceive as complementary products. Likewise, combinations such as baked beans/fruit juice and baked beans/cereals were assumed to be more distant from the perfect substitutability end of the continuum than the combination of coffee/tea and margarine/butter. These assumptions were made considering the conceptualization of substitutability proposed by Green and Freed (1993) which emphasizes the products' functionality. Presumptions about the degree of substitutability of each product combination were validated by 11 consumers on a scale of substitutability (see Appendix 3). Results supported the researchers' assumptions (see Appendix 4). The 10 combinations in order of substitutability-independence-complementarity were: margarine/butter, coffee/tea, fruit juice/tea, cereals/biscuits, cereals/baked beans, cereals/margarine, fruit juice/baked beans, biscuits/fruit juice, biscuits/coffee, and biscuits/tea. Participants who had bought the two product categories over the 16 weeks were then selected for the analysis of each product combination.

Measures and Analysis

The measures and analysis employed in this research consisted of an adaptation of those generally used in behavioral economics and matching research (Herrnstein, 1982; Herrnstein & Vaughan, 1980). Further information about the derivation of the precise measures used – summarized below – can be found in Foxall and James (2001, 2003; Foxall & Schrezenmaier, 2003).

Matching and Antimatching. The matching analysis performed in this research followed the procedure stated by Herrnstein (1997) in matching research with animal and human subjects. As noted briefly earlier, when applied to consumer research, the matching law can be translated as the proposition that the ratio of amount of money (pounds and pence; dollars and cents, etc.) spent for a product/brand to the amount spent on other near perfectly substitutable products (i.e. other brands of the same product category) will match the ratio of reinforcement earned (i.e., purchases made as a result of that spending) of that product/brand to the amount bought of other perfectly substitutable products (i.e., other brands of the same product category) (Foxall, 1999).

However, as stated before in this research some of the reinforcers used are considered to be what Kagel, Battalio and Green (1995) named gross complements (i.e., biscuits/tea; biscuits/coffee); therefore, for those combinations it is expected to find an antimatching effect rather than matching. On these considerations, the proposition above becomes: the amount of money spent for a product category to the amount spent on another product category (independent or grossly complementary), will show antimatching with the ratio of reinforcement earned of that product category to the amount bought of another product category (independent or grossly complementary). This was operationalised as follows: the *Response Ratio* was defined as the amount spent for a product category to the amount spent for a second product category: *Amount paid for product category A/Amount paid for product category B*. The *Reinforcement Ratio* was calculated in terms of the physical quantity bought: *Amount bought of product category A/Amount bought of product category B*. Analyses were conducted using logarithmic transformations.

In summary, the s parameter on the generalized equation proposed by Baum (1974) is expected to vary according to the level of substitutability of products. In this sense, it is expected that the slope will decrease from near perfect matching (for substitutable products such as margarine/butter) to antimatching (for complementary products such as biscuits/tea). Following Baum's (1974) propositions, slopes between 1.10 and 0.90 will

be considered near perfect matching. Slopes with values over 1.10 will be considered overmatching whereas any value between 0.90 and 0 will be regarded as undermatching. Values of $s<0$ will be interpreted as antimatching.

Schedule Analogues. As noted previously schedule analogues in terms of FR and VR3 have been implemented in this research. It is hoped that this distinction will allow exploration of whether consumers consider only the prices of different products available on each discrete shopping trip or whether their choice reflects the expected price-quantity relations over the extended period represented by a series of shopping trips. Generally the prices varied across weeks by pence/cents and not pounds/dollars although some prices did vary more due to promotions.

Results

The matching analysis was conducted for 10 different combinations of products that were assumed to vary in their degree of substitutability. Consumers that bought both products within the same week and/or within periods of three weeks on at least three different occasions were identified, and their ratios of response and reinforcement for each period were calculated. Additionally, aggregated analyses (including all data for all the consumers) were performed for the subset of consumers for each combination in the two different schedules of reinforcement. Table 1 displays the number and percentage of consumers identified on the original sample of 80 consumers for each combination of products within the two schedules of reinforcement.

Table 1 shows that the percentage of consumers buying the two products within each combination generally increased for the VR schedules. Biscuits/Fruit juice, (where the percentage remained the same) and Biscuits/Coffee (the number decreased by one in the VR schedule) were the single exceptions. This pattern is expected since the probability of buying the two commodities over a period of three weeks is larger than buying them within the same week. Therefore, some consumers that were not included for the FR schedules because they had not bought the two products on the same shopping occasion or week, were included on the VR schedule because they bought both products over periods of 3 weeks. However, a small number of consumers that were considered for the FR schedule analysis were not included for the VR analogues; the reason was that they bought the two products over three consecutive weeks, and therefore, when aggregating their choices over three weeks the results yielded less than two shopping periods (see Appendix 1).

The combination that produced the largest subset of consumers was cereals/biscuits (with almost half of the sample of consumers buying them over the same periods) and the one that yielded the smallest subset was coffee/tea (with less than 10% of shoppers buying both products over the same shopping periods). The reasons for these results could vary from combination to combination (e.g. it may be due to the differences on the products frequencies of purchase). For some product arrangements it could be due to the fact that consumers buy one or the other but not both products categories (which could be the case for margarine/butter and coffee/tea).

General Results

Figure 1 shows the percentage of consumers whose choice patterns indicated overmatching, matching, undermatching and antimatching, when calculated in terms of a weekly rate (FR

Table 1. Frequencies (fr) and Percentages (%) of consumers for product combination within FR and VR.

	FR Schedule		VR Schedule	
Product combination	**fr**	**%**	**Fr**	**%**
Margarine & Butter	7	9%	10	13%
Coffee & Tea	5	6%	6	8%
Fruit Juice & Tea	8	10%	9	11%
Cereals& Biscuits	37	46%	41	51%
Cereals& Beans	20	25%	27	34%
Cereals& Margarine	30	37%	35	44%
Fruit Juice & Beans	10	12%	16	20%
Biscuits & Fruit Juice	23	28%	23	29%
Biscuits & Coffee	12	15%	11	14%
Biscuits & Tea	17	21%	19	24%

schedule) for each product combination which ranged from substitutable to complementary pairs of products. As can be seen in Figure 1 (see also Appendix 2), for eight (out of 10) product combinations, undermatching was the most frequent form of choice behavior found. The highest percentage of undermatching was found for a combination of independent products (cereals/margarine = 67%) and the lowest among this group was exhibited by the complements biscuits/coffee (33%). However, for biscuits/tea this percentage did not differ from that found for overmatching (undermatching = overmatching = 35%), and in the case of biscuits/coffee not only was the percentage of under and overmatching identical, but it was also the same as matching (undermatching = overmatching = matching = 33%). These values indicate that, for different behavioral patterns, approximately the same number of consumers was found. For the other two combinations, undermatching was the second most predominant pattern (fruit juice/baked beans = 30% and coffee/tea = 40%).

The second most frequent pattern of behavior found was overmatching. The highest percentage was shown for the combinations of fruit juice/baked beans (70%) and coffee/tea (60%). As stated before, for two combinations (biscuits/coffee and biscuits/tea) there was a tie in the percentage of overmatching and other forms of behavioral allocation. The arrangement of fruit juice/tea yielded the smallest number of overmatching (13%). For five of the 6 remaining combinations, overmatching was the second most common performance. Cereals/biscuits constituted the single exception, with only 16% of consumers overmatching, and therefore this pattern was the third and not the second most common form of behavioral allocation. As happened in the case of undermatching, there were two product arrangements where the percentage of overmatching was the same as the one found for other patterns. Thus, for the substitutes margarine/butter, the percentage of consumers showing overmatching was the same as that found for near perfect matching (overmatching = matching = 29%). Likewise, in the case of fruit

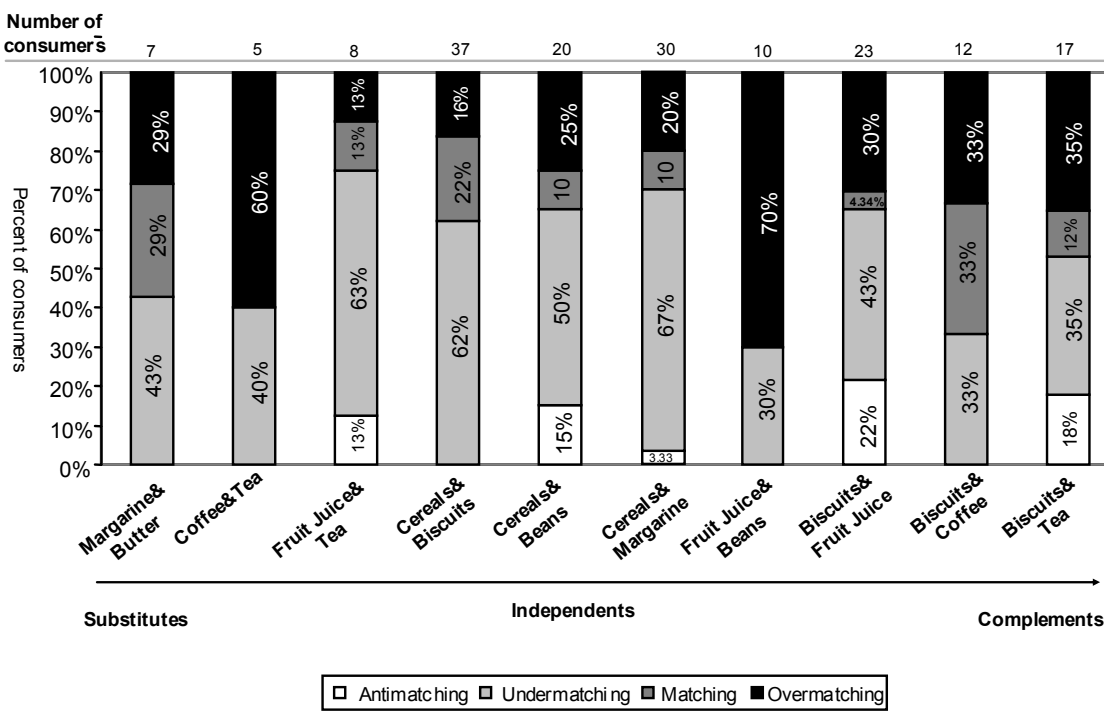

Figure 1. FR Schedule: Patterns of Matching Analysis (%).

juice/tea, the number of participants overmatching did not differ from those matching nor from the ones antimatching (overmatching = matching = antimatching = 13%).

In general, these two behavioral patterns account for between 67% (biscuits/coffee) and 100% (fruit juice/baked beans and coffee/tea) of consumers' choices. As a consequence, both matching and antimatching were generally infrequent. However, for three product combinations the frequency of matching was equal to (fruit juice/tea and margarine/butter) or greater than (cereals/biscuits) the frequency of overmatching. Furthermore, as stated previously, for the complements biscuits/coffee the percentage of matching was the same as the one found for over and undermatching. On five of the remaining combinations matching was the least frequent form of behavioral allocation. Specifically in the case of fruit juice/baked beans and coffee/tea there were no consumers who presented either this pattern or that of antimatching.

Finally, with values between 22% and 0%, antimatching was generally the least frequent pattern found (see Figure 1). The percentage of antimatching was the lowest on seven combinations, although in some of them this percentage was equal of that found for matching (baked beans/baked beans and coffee/tea) and even overmatching (tea/tea). For the remaining combinations (biscuits/baked beans, cereals/baked beans and biscuits/tea) this form of behavioral allocation was more frequent than matching. This pattern was not particularly linked to the level of substitutability between the product combinations.

Figure 2 shows the percentage of consumers whose choice patterns indicated overmatching, matching, undermatching and antimatching, when calculated over periods of three weeks (VR schedule) for each product combination which ranged from substitutable to complementary pairs of products. The figure indicates that the results for the matching analysis when the data were aggregated over periods of three weeks yielded an increase on the percentage of near perfect matching (values on the slope between 0.9 and 1.1) and the R^2 values (see Appendix 1), when compared to those shown in Figure 1. Although the percentage

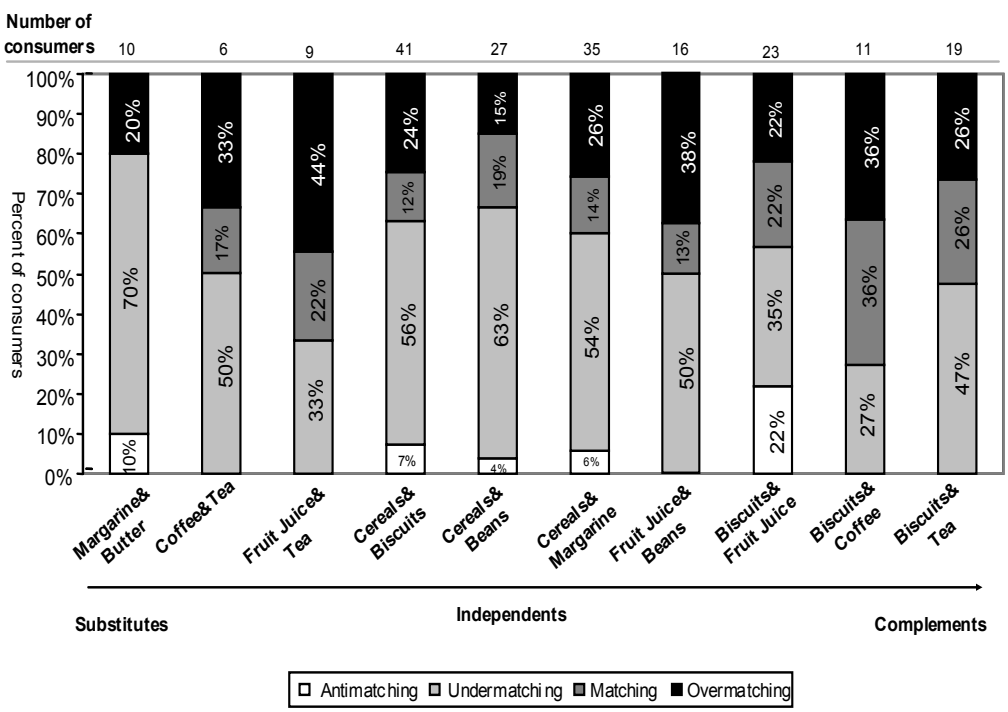

Figure 2. VR Schedule: Patterns of Matching Analysis (%).

of undermatching for five of the combinations decreased relative to the FR schedules, for nine of the ten product combinations this was the most common form of behavioral allocation. These values varied from 35% (biscuits/baked beans) to 70% for margarine/butter and they were generally slightly smaller for complementary combinations. Only for fruit juice/tea was the number of consumers showing overmatching greater than the one found for undermatching (overmatching= 44% and undermatching= 33%).

Despite the decrease in the percentage of overmatching for five product arrangements in relation to the conc FR FR, this was still the second most common pattern for seven combinations. As can be seen in Figure 2, the highest percentage of overmatching was found for fruit juice/tea (44%) where, as has been mentioned, it was the most common pattern. Among those where it was the second most frequent result, the highest value was 36% (biscuits/coffee) and the lowest 22% (biscuits/fruit juice). However, it is important to mention that in some of these cases the percentage of overmatching was the same as that found for matching (biscuits/tea and biscuits/coffee) and in the particular case of biscuits/fruit juice,

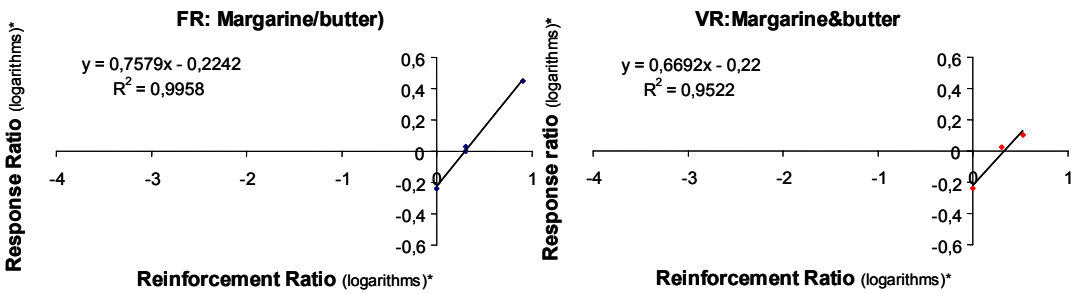

*Figure 3. Matching Analysis for subject 93182: Substitutable products (*log10).*

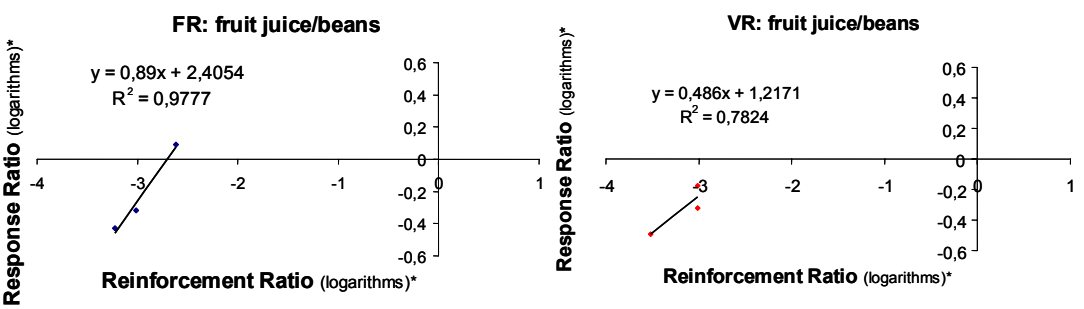

*Figure 4. Matching Analysis for subject 93182: Independent Products(*log10).*

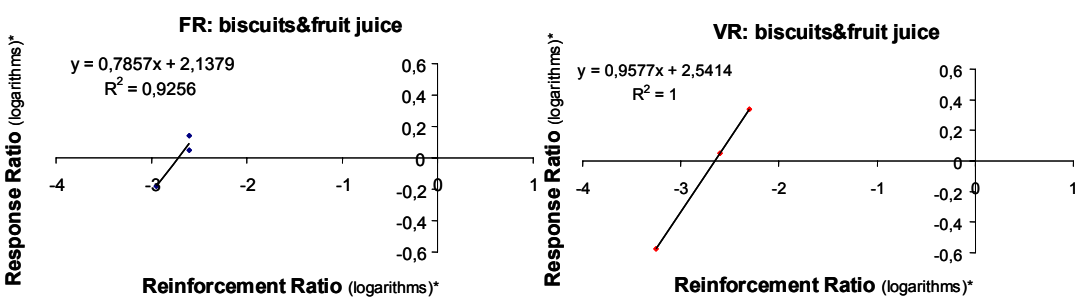

Figure 5. Matching Analysis for subject 93182: Complementary products.

these two percentages were equal to the number of consumers matching (overmatching = undermatching = matching = 21.73%). Finally, for the cereal/baked beans combination the percentage of overmatching was lower than the one found for matching (overmatching =14.81% and matching = 18.51%). No consumer showed overmatching in the case of margarine/butter; hence, it was (by trivial definition) the least frequent pattern for that combination.

As has been mentioned, when consumers' choices were aggregated over three week periods, the results show a greater percentage of near perfect matching than those for the weekly integration of behavior. This was the case for eight of the ten combinations. Thus, for five combinations (cereals/baked beans, biscuits/coffee; biscuits/tea, biscuits/fruit juice and margarine/butter) matching yielded the second greatest percentage of consumers. Once again, in some cases this percentage did not differ from the one of overmatching and in one case it did not even differ from that found for antimatching. For the remaining combinations, the percentage of matching was greater than that found for antimatching, which was the most infrequent behavioral allocation.

For 8 of the 10 combinations, the least frequent pattern was antimatching (Figure 2). The highest percentage of antimatching was found for biscuits/fruit juice (22%) whereas for five combinations (biscuits/tea, biscuits/coffee, fruit juice/tea, fruit juice/baked beans and coffee/tea) there no consumer displayed antimatching. Hence, no relation with the level of substitutability was found.

Illustrative example: An individual case. Consumer number 93182 was chosen to illustrate the results at an individual level since this shopper uniquely purchased three combinations that differed in their level of substitutability. The following figures illustrate the pattern found for this consumer 93182 where margarine/butter were assumed to be perceived as substitutes (based on the results of the analysis of the substitutability scale- see appendices 3 and 4 and section 2.2), fruit juice/baked beans as independents, and biscuits/fruit juice as complements.

As illustrated in Figures 3, 4 and 5, for this particular consumer the slopes decreased when the data were aggregated over periods of three weeks for the substitutable products and for the independent products. By contrast, for the combination of complementary products the slope increased for the conc VR VR. Likewise, and contrary to the predictions, the slopes did not decrease according to the level of substitutability-independency-complementarity. Different patterns emerged for different participants (see Appendix 1).

Aggregated Analysis

Table 2 summarizes the results of the general equation model found at an aggregated (across

Table 2. Generalized equation: Aggregated level.

	FR Schedule			VR Schedule		
Product Combination	**Slope**	**Intercept**	**R^2**	**Slope**	**Intercept**	**R^2**
Margarine/Butter	-0.67	0.23	0.20	0.58	-0.21	0.21
Tea/Coffee	1.03	-0.61	0.72	1.08	-0.55	0.88
Fruitjuice/Tea	0.65	1.49	0.72	0.81	1.84	0.82
Cereals/Biscuits	0.85	0.07	0.65	0.95	0.03	0.72
Cereals/Beans	0.89	0.58	0.74	1.08	0.51	0.70
Cereals/Margarine	0.84	-0.26	0.45	0.90	0.21	0.58
Biscuits/Fruitjuice	0.55	1.45	0.27	0.85	2.20	0.64
Fruitjuice/Beans	0.50	1.70	0.31	1	3.00	0.46
Biscuits/Coffee	0.46	-0.52	0.65	0.71	-0.67	0.70
Biscuits/Tea	0.60	-0.29	0.74	0.81	-0.34	0.80

all purchases and individuals) level for each product combination. For this analysis the quantity bought and the amount spent for each product category on different shopping occasions were summarized. Then, the ratio of *the total amount bought for one product/total amount paid for both products* and the ratio of *the total amount paid for one product/total amount spent for the two products* during the 16 weeks was calculated. For the concurrent FR FR only the data from those occasions where the consumers bought both products on the same shopping trip were considered. Likewise, for the aggregated analysis of the conc VR VR, the only data used corresponded to those occasions where the consumers had bought both products over periods of three weeks. Each data point in the equation corresponded to the choices of one consumer along the 16 weeks of data collection from the FR and VR schedules.

The slopes varied between -0.668 to 1.030 for the FR schedules. The general tendency of the slope was to decrease with the combinations' level of substitutability (with the single exception of margarine/butter which yielded antimatching,

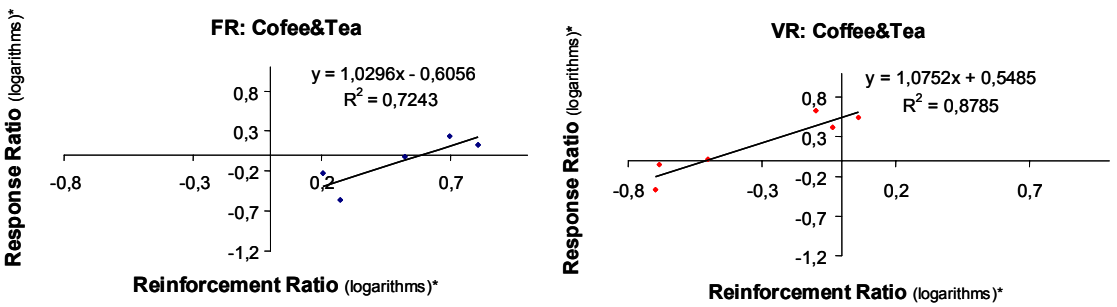

Figure 6. Matching analysis: Substitutable Products.

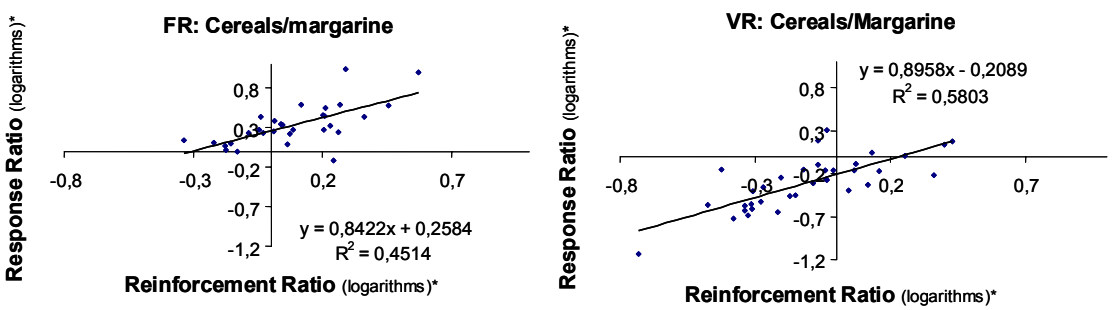

Figure 7. Matching Analysis: Independent Products.

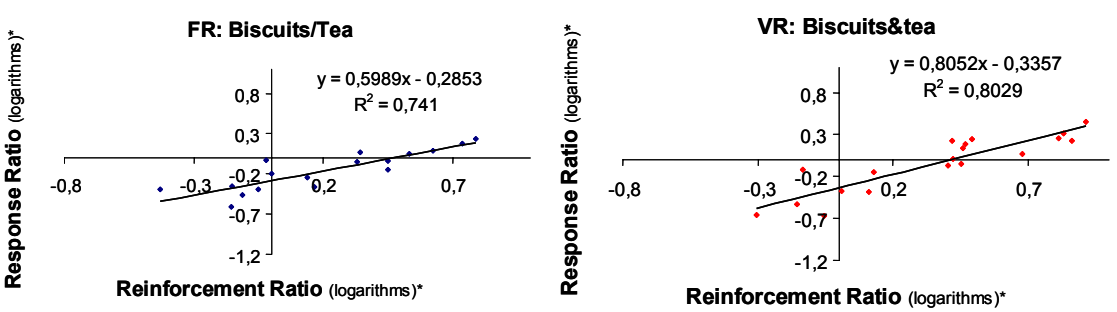

Figure 8. Matching Analysis: Complementary products.

but the very low R^2 and the small number of consumers that bought both products imply that this results has to be considered carefully). In this sense, highly substitutable products like tea/coffee, exhibit the greatest slope values showing a near perfect matching pattern, whereas for products that were ranked as independents the slope tends to decrease (as it is the case for cereals/margarine s= 0.842) indicating undermatching. Finally, for complementary products the slopes were around 0.5 indicating clear undermatching. All the intercept values differed markedly from unity, indicating that some unknown but invariant bias caused some degree of asymmetry between the options. The R^2 values varied from 0.202 to 0.743. For three product combinations (margarine/butter, biscuits/fruit juice and fruit juice/baked beans) this parameter was very low, indicating great dispersion and therefore low adjustment of the data to the model. For the remaining 7 combinations, the R^2 was higher than 0.45, denoting a moderate to high adjustment to the model.

A rather different pattern was found for the conc VR VR schedule. In this case the s parameter was generally very high. With the exception of margarine/butter (s = 0.583), the values fell in the range of 0.705 to 1.075. For three combinations (tea/coffee, cereals/biscuits and fruit juice/baked beans) the slope indicated near perfect matching. Finally, despite the fact that the s parameter for the remaining 6 combinations fell on the range of undermatching, they were closer to unity than they were for the FR schedule. As for the weekly-integrated data, the intercept for the VR schedule differed significantly from unity, suggesting consistency in choices due to unknown reasons. With exception of the margarine/butter combination (R^2= 0.210), the degree of adjustment to the model for this schedule of reinforcement was from moderate to high. The values for this parameter yielded between 0.461 (for fruit juice/baked beans) up to 0.878 (for tea/coffee).

Illustrative example: Aggregated results. Based on the degree of substitutability assumed by the researcher (and validated by 11 consumers), and the degree of adjustment to the model (R square) the combination tea/coffee was selected as an example of perfectly substitutable goods, cereals/margarine as independents and biscuits/tea as complements. The results for the aggregated results are shown in Figures 6, 7 and 8.

The examples illustrate the decrease of the slope of the general matching equation with different degrees of substitutability at an aggregated level. As can be seen in the Figures above, for the conc FR FR the slope for the combination of coffee/tea (which were assumed to be substitutes) shows near perfect matching, for the independent (cereals/margarine) the slope indicates undermatching although it is close to the matching cut off (0.90) chosen considering Baum's (1974) proposition . For the complementary products (biscuits/tea) undermatching was also found, but in this case the slope was much closer to 0. The illustration also shows how for the conc VR VR these differences among the substitutability continuum were not evidenced, because the slope did *not* vary substantially from one product combination to the other.

Discussion

Individual analysis

The results reported here differ markedly, but as predicted, from those obtained in earlier research that focused on brands rather than product categories (Foxall and James, 2001). The frequencies of over and undermatching (especially when analyses where conducted on a weekly basis) were particularly high. It is noteworthy that product categories that were perceived as substitutes (e.g., margarine/butter and coffee/tea) yielded an unexpected number of cases of overmatching and undermatching compared with the predominant matching patterns found for brands within the same product category. The low percentages of consumers for the most substitutable products (margarine/butter and coffee/tea) suggest that even when consumers practice multi-brand purchasing (as Ehrenberg, 1988, proposed and Foxall and Schrezenmaier, 2004, confirmed) they would not substitute them as easily for a different (although in some respects equivalent) product category. Furthermore, for consumers who bought the two products, relatively few evinced matching in their patterns of choice, suggesting that these consumers do not see them as near substitutes. In other words, it appears that in order to achieve

perfect matching the reinforcers have to function as potential substitutes and be seen to belong to the same product category.

At the individual level, different degrees of substitutability did not produce different percentages of matching patterns. Thus, some consumers showed matching with complementary products (e.g., 4 consumers showed matching on the biscuits/coffee combinations); and others, antimatching patterns with independent commodities (e.g., 3 participants performed according to the antimatching effect with the combination of cereals/beans). Differences in participants' history of reinforcement are suggested by the variety of patterns found for each product combination. A similar source of variation might be found in the fact that different consumers could have different perceptions about the degree of the combinations' substitutability, in terms of products providing different functions for different consumers. This could perhaps be related to their learning history with these products. In their investigation, Foxall and James (2001) analyzed the data for only one consumer per product combination and they qualitatively explored the participants' degree of substitutability for each product/brand they used. Although for the current research a group of 11 consumers were asked to allocate the combinations along the substitutability continuum in order to validate the theoretical assumptions, the perception of each of the shoppers that took part on the analysis are not available, and therefore it is not possible to contrast their views with their results.

Aggregated analyses over the sample: FR vs. VR schedules

When the data for the conc FR FR analysis were aggregated (the summary of the results from one subject was calculated and therefore each subject constituted a data point), results were more consistent with the expected patterns. For this schedule, the s parameter decreased with changes on the degree of substitutability according to what the theory predicts. In this sense, assuming that the use of multiple consumers minimizes the effect of individual perceptions of substitutability (and perhaps therefore variation in their learning histories), we may conclude that the *s* parameter is indeed a measure of substitutability at least when data are considered on a weekly basis. Thus, the results for the entire sample seem to demonstrate that, on a single shopping occasion, consumers would match the ratio of amount of money spent on one product to the amount spent on other near substitutable products with the ratio of reinforcement earned of that product to the amount bought of other close substitutable products. Undermatching could then be expected for independent products and slopes nearer 0 for complementary products.

Nonetheless, the antimatching effect proposed by Kagel, Battalio and Green (1995) for complementary combinations was not found. Although the combinations of biscuits/tea and biscuits/coffee were identified (using the results of the substitutability scale questionnaire) by consumers as complementary products, it seems that those products are still able to achieve their purposes quite independently of the presence of the other. Therefore, even when these product combinations show a very clear deviation from matching, they still do not result in antimatching. Further research seems to be needed using product combinations with higher levels of complementarity, where the function of one product is truly compromised if the other product is absent. Generally, products whose consumption necessarily increases with the increase of the consumption of another product or which in behavioral terms, need to be presented jointly in the consumption situation to achieve their role as reinforcers. Such combinations of complementary produces as cereals and milk, shampoo and hair conditioner, coffee and milk) are recommended for future research.

By contrast, when the data was analyzed for periods of three weeks, the slope tended to increase: buyer behavior for independent combinations of which the slopes were generally around 0.80 on the FR schedule, and consequently not high enough to be considered matching, showed near perfect matching on the conc VR VR schedules. Likewise, for complementary products that showed clear undermatching, the slopes increased so that they were closer to unity (although in some cases not high enough to be considered matching, e.g., biscuits/coffee).

Similarly to Foxall and James (2003), results from the current research show that parameter *b* in both FR and VR schedules differed significantly toward unity, suggesting possible biases of the form of availability of products, and extra-cost associated with each product (e.g. because of their shelf positions in the supermarket).

Conclusions

According to Kagel, et al. (1995) when subjects are in the presence of complementary reinforcers, results will differ from the matching pattern proposed by Herrnstein (1961) showing what they called "antimatching". On a consumer setting, at an individual base, Foxall and James (2001) found this effect only when the data were grouped over periods of three weeks. The current research failed to find systematic variations on the s parameter of the generalized matching equation for the different levels of substitutability at an individual level. Moreover, with complementary products the percentage of antimatching found was relatively low in comparison with other forms of behavioral allocation. There seems to be a need for further research with complementary product combinations that really require each other to achieve their purposes.

However, by aggregating the data (minimizing the effect that individual perceptions, and individual learning histories, could have on behavior), results approached the expected patterns. In this case, the slope of the generalized equation decreased according to the level of substitutability- independence-complementarity, although this effect was found exclusively when occasions were considered on a weekly base. These results allow the conclusion that, when considered at an aggregated level, consumers seem to consider the prices of different products available within a shopping trip, and behave according to what is predicted by the generalized matching law for different levels of substitutability. Nonetheless, over extended periods, represented by series of three shopping trips, consumers tend to match their choices even with qualitatively different reinforcers.

Further research and implications

This paper has given an indication of the effects of substitutability and complementarity on matching relationships. Further research with a large data set is underway already to access the extent and usefulness of these patterns. Without extending this study to this larger dataset, we cannot be certain about the useful extent of these findings in terms of marketing theory, strategy and general marketing practice. This is especially the case as much marketing planning is based on aggregated findings from a large number (often thousands) of consumers. Certainly it would also be extremely useful to look at a wider range of product pairings and, at a deeper level, at the effect of brands and sections of products (for example- sweet and savory biscuits). Making early predictions it seems that the work could affect primarily the pricing structure adopted and the positioning of products, in terms of place (for example if complementary products were not available in the same shop).

Further research could also extend the analysis of the levels of substitutability, independence and complementarity. This could be done initially by using the substitutability scale questionnaire on a wider range of product combinations and using a wider range of participants. It could further employ a split-sample procedure and use economic determinants of substitutability, such as the relationships between quantities consumed of different brands/products.

Alongside further studies using data aggregated across consumers, separate work could also explore more individual patterns, perhaps incorporating a qualitative dimension as in the work of Foxall and James (2001, 2003). This would also allow a better understanding of what the role of verbal behavior might be in research on consumer choice behavior. Certainly the difference between verbal behavior about what might be or has been bought and actual observed purchase patterns might provide valuable information to researchers. Looking at individuals would also allow us to look more closely at individual perceptions of substitutability and determine the best course or action for controlling these, and other aspects of the individuals learning history, in future research.

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Appendix 1: Results for the generalized matching law

Margarine/Butter							
	FR Schedules				VR Schedules		
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
				12347	0.55	-0.23	0.75
55815	1.36	-1.24	0.64	55815	0.89	-1.00	0.57
86295	1.22	-0.36	0.61	86295	1.03	-0.31	0.70
93182	0.76	-0.22	1.00	93182	0.67	-0.22	0.95
98732	0.90	-0.30	0.43	98732	0.71	-0.20	0.93
				124244	0.85	-0.01	0.95
				126874	-0.03	0.07	0.02
129274	0.94	-0.20	1.00	129274	1.02	-0.23	1.00
131294	0.35	-0.30	0.22	131294	0.54	-0.46	0.97
133271	0.62	0.25	0.38	133271	0.65	0.19	0.95
Average	0.88	-0.34	0.61	Average	0.69	-0.45	0.78

Tea/Coffee							
	FR Schedule				VR Schedule		
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
				21174	1.02	-0.48	0.99
59984	1.17	-0.66	0.99	59984	1.24	-0.67	0.98
67380	0.31	-0.27	0.62	67380	0.55	-0.40	0.81
75262	2.23	-1.15	0.98	75262	2.00	-0.80	0.37
131331	1.10	-0.60	0.43	131331	0.43	0.09	0.15
600817	0.45	-0.26	0.93	600817	0.58	-0.33	0.83
Average	1.05	-0.59	0.79	Average	0.96	-0.42	0.63

Fruit Juice/Tea							
	FR Schedule				VR Schedule		
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
27180	0.22	0.50	0.25	27180	3.44	7.24	0.97
76872	1.85	4.10	0.86	76872	0.97	2.18	0.74
82032	0.67	1.49	0.52	82032	0.91	2.02	0.94
				122025	1.17	2.54	0.97
122753	0.68	1.58	0.99	122753	0.45	1.30	0.52
124559	-1.61	-3.42	0.29	124559	2.10	5.04	0.46
				128130	0.39	0.72	0.35
133271	0.51	1.07	1.00	133271	0.43	1.19	0.94
600817	0.98	2.22	0.76	600817	1.41	3.28	0.82
131357	0.87	2.04	0.93				
Average	0.52	1.20	0.70	Average	1.25	2.84	0.75

Cereals/Biscuits

Cereals/Biscuits							
FR Schedules				VR Schedules			
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
12347	0.92	0.03	0.82	**12347**	1.30	0.04	0.94
21174	1.29	0.28	0.80	**21174**	1.09	0.26	0.77
25927	0.58	0.00	0.47	**25927**	0.89	-0.02	0.83
27180	0.43	-0.16	0.80	**27180**	0.50	-0.20	0.99
31639	0.35	-0.11	0.29	**31639**	0.84	-0.20	0.71
36543	1.06	0.18	0.99	**36543**	1.05	0.22	0.98
36968	0.77	0.15	0.77	**36968**	1.18	-0.18	0.70
48996	0.96	-0.05	0.72	**48996**	0.81	-0.05	0.49
55814	0.83	-0.13	0.41				
55815	0.53	0.09	0.33	**55815**	0.14	0.12	0.38
60695	0.43	0.19	0.46	**60695**	1.38	0.19	1.00
61529	0.27	-0.12	0.07	**61529**	0.61	-0.19	0.46
74108	0.64	0.33	0.03	**74108**	0.25	0.38	0.20
78082	1.26	0.06	0.93	**78082**	1.25	0.08	0.90
86240	0.82	0.10	0.78	**86240**	0.15	0.66	0.22
86295	0.81	-0.01	0.73				
90910	0.66	0.22	0.64	**90910**	0.93	0.08	0.81
93182	1.45	0.13	0.99	**93182**	1.34	0.11	0.97
95606	0.28	0.08	0.08	**95606**	0.61	0.03	0.40
106627	1.19	0.22	0.60	**106627**	-0.19	0.00	0.04
				106715	-0.96	0.22	0.97
113815	0.23	-0.07	0.01	**113815**	2.47	0.40	0.84
118278	1.21	-0.05	0.67	**118278**	1.41	-0.27	0.78
122016	0.98	0.04	0.82	**122016**	0.88	0.14	0.96
				122025	0.28	0.22	0.47
122718	1.04	0.30	0.87	**122718**	1.20	0.35	0.97
122753	1.09	-0.36	0.87	**122753**	1.03	-0.34	0.92
				124244	0.07	0.26	0.02
124559	0.46	0.13	0.45	**124559**	0.48	0.12	0.50
124933	0.35	0.29	0.32	**124933**	0.88	0.13	0.81
126110	0.47	0.16	0.59	**126110**	0.50	0.21	0.22
				126831	-0.80	-0.68	0.16
126874	1.19	0.17	0.54	**126874**	1.23	0.15	0.87
128130	1.08	0.16	0.62	**128130**	0.81	0.09	0.70
130953	0.54	0.20	0.77	**130953**	0.58	-0.02	0.67
				131294	0.92	-0.30	0.78
131331	0.75	0.19	0.73	**131331**	0.48	0.18	0.38
131357	0.87	0.12	0.24	**131357**	0.27	0.24	0.03
				132207	0.88	-0.10	0.97
132764	0.42	-0.10	0.25	**132764**	1.49	-0.33	0.44
600031	0.88	0.06	0.89	**600031**	0.77	0.14	0.81
600817	0.66	0.04	0.28	**600817**	0.42	-0.05	0.13
600948	1.00	0.35	0.64	**600948**	0.78	0.36	0.27
Average	0.78	0.08	0.57	**Average**	0.74	0.06	0.62

Cereals/Beans							
FR Schedule				VR Schedule			
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
21174	1.50	0.94	0.99	**21174**	0.49	0.71	0.48
25927	0.54	0.41	0.26	**25927**	0.55	0.47	0.43
26537	0.10	1.22	0.02	**26537**	1.55	-0.06	0.95
27180	-0.73	0.22	0.08	**27180**	0.73	0.19	0.17
48996	0.54	0.35	0.73	**48996**	0.74	0.25	0.71
55814	-1.79	1.18	0.68	**55814**	0.89	0.49	0.93
55815	1.54	0.58	0.82	**55815**	0.71	0.81	0.48
58275	0.36	1.11	0.28	**58275**	0.96	0.89	0.86
61529	0.21	0.57	0.16	**61529**	0.61	0.64	0.45
				74108	0.46	1.08	0.11
93182	1.12	0.55	0.70	**93182**	0.74	0.54	0.67
				95606	0.43	0.83	0.87
106627	0.99	0.80	0.75	**106627**	1.68	1.07	0.59
113815	0.63	0.66	0.06	**113815**	0.77	0.47	0.39
118278	1.98	-0.05	0.89	**118278**	1.99	-0.06	0.89
				122404	0.80	0.06	0.83
122718	0.67	0.46	0.83	**122718**	0.94	0.60	0.95
				128130	0.14	0.52	0.00
130953	0.75	1.02	0.69	**130953**	0.25	0.89	0.07
				131294	1.09	-0.25	0.75
131331	0.90	0.55	0.96	**131331**	0.93	0.57	1.00
131357	-5.21	0.62	0.86	**131357**	0.50	0.85	0.40
				132207	0.42	0.14	0.85
132764	0.42	0.14	0.83	**132764**	-0.47	0.22	0.35
600031	0.69	0.31	0.58	**600031**	0.06	-0.16	0.01
				600469	1.04	0.22	0.87
600817	0.41	0.60	0.20	**600817**	1.35	0.49	0.63
Average	0.28	0.61	0.57	**Average**	0.75	0.46	0.58

Beans/Fruit Juice							
FR schedule				VR Schedule			
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
				23527	0.68	-2.56	0.13
25927	1.11	-3.22	0.47	**25927**	1.45	-4.08	0.70
				27180	0.65	-1.62	0.12
29436	1.13	-3.10	0.95	**29436**	1.11	-3.18	0.62
48996	1.26	-2.97	0.54	**48996**	0.87	-2.23	0.80
55815	0.49	-1.88	0.35	**55815**	0.61	-2.20	0.61
58275	1.33	-4.28	0.15	**58275**	1.13	-3.78	0.37
				74108	1.58	-4.50	1.00
82032	1.29	-4.03	0.85	**82032**	1.35	-4.25	1.00
93182	0.89	-2.41	0.98	**93182**	0.49	-1.22	0.78
				113815	1.48	-4.29	1.00
118278	1.72	-4.75	1.00	**118278**	1.72	-4.76	1.00

				128130	1.07	-3.11	0.41
132207	0.42	-1.52	0.86	**132207**	0.64	-2.23	0.69
				132764	0.97	-2.75	0.83
				600817	0.80	-2.70	0.64
130867	1.33	-3.16	0.99				
Average	1.10	-3.13	0.71	**Average**	1.04	-3.09	0.67

Cereals/Margarine

FR Schedule				**VR Schedule**			
Consumer Number	**Slope**	**Intercept**	**R^2**	**Consumer Number**	**Slope**	**Intercept**	**R^2**
12347	0.72	0.47	0.55	**12347**	0.99	0.41	0.31
21174	0.87	0.30	1.00	**21174**	0.94	0.32	1.00
26537	0.84	0.37	0.98	**26537**	0.93	0.38	0.99
27180	0.68	0.20	0.72	**27180**	0.73	0.18	0.99
36543	1.42	-0.07	0.38	**36543**	0.69	0.19	0.81
48996	1.21	0.31	0.57	**48996**	1.55	0.17	0.83
55815	2.99	0.36	0.90	**55815**	0.69	0.43	0.70
61529	1.09	0.00	0.91	**61529**	1.33	0.00	0.92
67380	0.39	0.08	0.54	**67380**	0.68	0.11	0.46
74108	0.67	0.36	0.96	**74108**	-0.04	0.19	0.00
78082	1.10	0.19	0.85	**78082**	0.53	0.40	0.35
				84030	1.24	0.22	1.00
86240	0.40	1.16	0.11	**86240**	1.57	0.03	0.78
90910	0.56	0.28	0.98	**90910**	0.72	0.30	0.99
93182	0.96	0.16	0.99	**93182**	0.98	0.19	0.96
95606	-0.28	0.36	0.01	**95606**	-0.02	0.62	0.00
106627	1.30	0.39	0.38	**106627**	0.83	0.45	0.53
122016	0.52	0.22	0.51	**122016**	0.63	0.24	0.82
				122025	0.53	0.14	0.68
122718	0.82	0.31	0.95	**122718**	0.81	0.37	0.98
				124244	0.54	0.00	0.82
124559	0.64	0.80	0.36	**124559**	0.44	0.36	0.52
124933	0.59	0.16	0.99	**124933**	0.52	0.25	0.86
126110	0.74	0.30	0.84	**126110**	1.05	0.23	0.97
126874	0.21	0.30	0.02	**126874**	1.13	0.17	0.58
128130	0.29	0.15	0.01	**128130**	0.76	0.19	0.80
				129274	1.12	0.25	1.00
130953	0.55	0.13	0.77	**130953**	0.32	-0.07	0.38
				131294	2.90	-0.41	0.98
131331	0.63	0.18	0.53	**131331**	0.54	0.24	0.39
132764	1.20	0.11	0.96	**132764**	1.26	0.13	0.98
133271	0.27	-0.14	0.13	**133271**	0.77	-0.33	0.82
600031	0.83	0.10	0.89	**600031**	0.56	0.03	0.79
600817	0.94	0.18	0.46	**600817**	0.86	0.12	0.55
				600948	1.14	-0.34	0.80
86295	0.63	0.41	0.83				
Average	0.79	0.27	0.64	**Average**	0.86	0.18	0.72

Fruit Juice/Biscuits							
FR Schedule				VR schedule			
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
25927	0.84	1.97	0.70	**25927**	0.91	2.11	0.99
27180	0.74	1.75	0.41	**27180**	0.69	1.48	0.92
29436	2.23	5.80	0.99	**29436**	1.15	3.32	0.64
48996	0.82	1.82	0.47	**48996**	0.56	1.15	0.59
55815	0.73	1.72	0.64	**55815**	0.69	1.62	0.98
				74108	1.06	2.63	0.98
78082	-0.88	-1.99	0.40	**78082**	1.96	5.43	1.00
82032	-0.33	-0.52	0.02	**82032**	-0.37	-0.63	0.04
86240	0.73	1.98	0.43	**86240**	-0.52	-1.14	0.03
86295	-1.36	-2.45	0.93	**86295**	-0.13	0.11	0.09
93182	0.79	2.14	0.93	**93182**	0.96	2.54	1.00
106715	-1.17	-3.07	0.72	**106715**	-1.16	-3.07	0.69
113815	0.99	2.54	0.90	**113815**	0.83	2.04	0.96
118278	1.32	3.10	0.32	**118278**	1.46	3.41	0.47
122016	0.65	1.77	0.78	**122016**	1.23	3.12	0.35
122025	2.25	5.62	0.15	**122025**	0.89	2.26	0.35
122753	1.15	2.97	0.91	**122753**	1.09	2.78	0.94
124559	-0.02	0.42	0.12	**124559**	0.35	1.01	0.22
126874	1.66	4.41	0.76	**126874**	1.05	2.69	0.83
128130	0.24	0.53	0.05	**128130**	0.13	0.16	0.04
				132207	0.64	1.80	0.56
132764	0.27	0.67	0.32	**132764**	-0.01	-0.15	0.00
600817	1.12	2.92	0.85	**600817**	1.31	3.53	0.87
36968	1.31	3.30	0.53				
47278	0.66	1.37	0.22				
Average	0.64	1.69	0.54	**Average**	0.64	1.66	0.59

Biscuits/Coffee							
FR Schedules				VR Schedules			
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
21174	1.74	-1.74	0.76	**21174**	1.77	-1.69	0.86
25927	0.71	-0.60	0.71	**25927**	0.72	-0.53	0.97
31639	1.03	-0.80	0.91	**31639**	1.13	-0.86	0.98
86240	0.95	-0.87	0.71	**86240**	1.23	-1.08	0.57
86295	1.05	-0.80	0.80	**86295**	0.95	-0.87	0.71
126874	1.37	-1.48	0.75	**126874**	0.95	-0.87	0.71
130953	0.81	-0.72	0.35	**130953**	0.95	-0.87	0.71
131294	0.58	-0.94	0.34	**131294**	0.68	-1.12	0.72
131331	1.21	-1.23	0.46	**131331**	0.54	-0.31	0.91
131357	0.64	-0.46	0.95				
132207	1.71	-0.99	0.87	**132207**	1.57	-0.88	0.96
600817.00	0.95	-0.87	0.71	**600817**	0.92	-0.78	0.90
Average	1.06	-0.96	0.69	**Average**	1.04	-0.90	0.82

Biscuits/Tea							
FR Schedules				VR Schedules			
Consumer Number	Slope	Intercept	R^2	Consumer Number	Slope	Intercept	R^2
21174	1.72	-1.13	0.98	**21174**	1.34	-0.86	0.93
27180	0.26	-0.20	0.08	**27180**	0.38	-0.08	0.26
31639	1.11	0.03	0.96	**31639**	0.96	0.00	0.97
36543	0.84	-0.38	0.83	**36543**	0.82	-0.40	7898.00
				74108	0.96	-0.39	0.83
78082	-1.88	-0.64	0.16	**78082**	1.56	-0.55	0.97
82032	-0.20	-0.52	0.01	**82032**	0.59	-0.47	0.67
98732	0.84	-0.40	0.79	**98732**	0.66	-0.29	0.81
113815	-0.04	-0.02	0.00	**113815**	0.17	0.17	0.87
122025	1.61	-0.22	0.48	**122025**	0.29	-0.19	0.18
122718	1.35	-0.66	0.44	**122718**	1.58	-1.00	0.71
				122753	0.95	-0.32	0.97
122990	0.98	-0.49	1.00	**122990**	0.91	-0.49	0.99
124244	0.65	-0.39	0.82	**124244**	0.63	-0.49	0.72
				124933	1.53	-0.57	0.94
126110	0.33	-0.43	0.28	**126110**	0.73	-0.31	0.64
128130	0.38	-0.30	0.14	**128130**	0.76	-0.39	0.75
131331	1.35	-0.75	0.43	**131331**	1.01	-0.61	0.40
600817	0.94	-0.29	0.94	**600817**	1.15	-0.37	0.89
124559	1.61	-0.99	0.90				
Average	0.70	-0.46	0.54	**Average**	0.89	-0.40	416.39

Appendix 2: Matching patterns percentages

	FR Schedule								
	Antimatching		Undermatching		Near Perfect Matching		Overmatching		Fr
	Fr	%	fr	%	fr	%	fr	%	fr
Margarine&Butter	0	0%	3	43%	2	28.57%	2	28.57%	7
Coffee&Tea	0	0%	2	40%	0	0%	3	60%	5
Fruit Juice&Tea	1	12.50%	5	63%	1	12.50%	1	12.50%	8
Cereals&Biscuits	0	0%	23	62.22%	8	21.62%	6	16.21%	37
Cereals&Beans	3	15%	10	50%	2	10%	5	25%	20
Cereals&Margarine	1	3.33%	20	67%	3	10%	6	20%	30
Fruit Juice&Beans	0	0%	3	30%	0	0%	7	70%	10
Biscuits&Fruit Juice	5	21.73%	10	43.47%	1	4.34%	7	30.43%	23
Biscuits&Coffee	0	0%	4	33.33%	4	33.33%	4	33.33%	12
Biscuits& Tea	3	17.64%	6	35.29%	2	11.78%	6	35.29%	17
	VR Schedule								
	Fr	%	fr	%	fr	%	fr	%	fr
Margarine&Butter	1	10%	7	70%	2	20%	0	0%	10
Coffee&Tea	0	0%	3	50%	1	16.66%	2	33%	6
Fruit Juice&Tea	0	0%	3	33.33%	2	22.23%	4	44.44%	9
Cereals&Biscuits	3	7.31%	23	56.09%	5	12.21%	10	24.39%	41
Cereals&Beans	1	3.7%	17	62.96%	5	18.51%	4	14.81%	27
Cereals&Margarine	2	5.71%	19	54%	5	14.28%	9	25.71%	35
Fruit Juice&Beans	0	0%	8	50%	2	12.5%	6	37.50%	16
Biscuits&Fruit Juice	5	21.73%	8	34.78%	5	21.73%	5	21.73%	23
Biscuits&Coffee	0	0%	3	27.27%	4	36.36%	4	36.36	11
Biscuits& Tea	0	0%	9	47.36%	5	26.31%	5	26.31%	19

Appendix 3: Substitutability Scale

Exeter University
Substitutability Scale

Considering ***Substitutability*** as the degree to which two products can serve the same purpose, please rate the degree of substitutability of the following commodities. In the following scale ***1 corresponds to complete substitutability***, the middle point ***4 corresponds to Independency*** (where the products serve two completely different purposes), and ***7 means that you see the products as complements*** (one product needs the other to achieve its purpose).

	Substitutes			Independents			Complements
Product Categories	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Cereals& Beans							
Cereals& Margarine							
Cereals& Biscuits							
Biscuits& Tea							
Biscuits& Coffee							
Biscuits& Fruit Juice							
Fruit Juice& Tea							
Fruit Juice& Beans							
Coffee&Tea							
Margarine&Butter							

Appendix 4: Descriptive Statistics - Substitutability levels

	N	Minimum	Maximum	Mean	Std. Deviation
Margarine/butter	11	1	4	1.363636	0.924416
Coffee/tea	11	1	5	1.363636	1.206045
Fruit juice/tea	11	1	4	2.363636	1.206045
Cereals/biscuits	11	1	5	2.909091	1.30035
Cereals/beans	11	1	4	3.363636	1.026911
Cereals/margarine	11	4	4	4	0
Fruit juice/beans	11	3	5	4.090909	0.53936
Biscuits/fruit juice	11	4	7	4.727273	0.904534
Biscuits/tea	11	4	7	6.181818	1.07872
Biscuits/coffee	11	4	7	6.181818	1.07872