



Grocery retail loyalty program effects: Self-selection or purchase behavior change?

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Topics Discussed

- Context & Definition Loyalty program (LP)
- Empirical evidence about LP efficiency
- Conceptual Framework about Efficiency of Loyalty Program
- 1st Investigation and data
- Results about Efficiency of Loyalty Programs
- Conceptual Framework about how to improve Loyalty Program
- 2nd investigation and data
- Results about how to improve Loyalty Programs



Loyalty Program (LP)



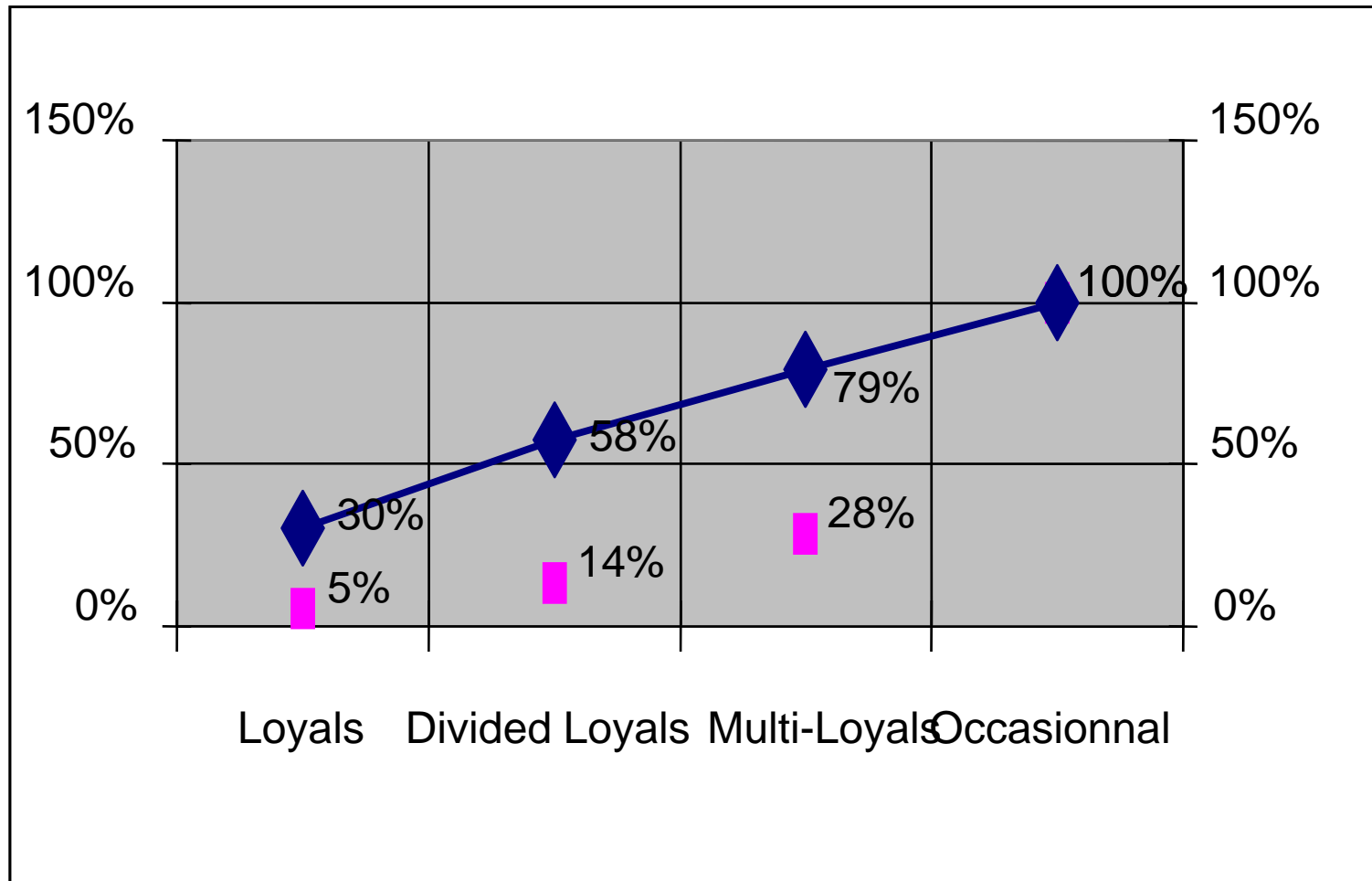
- Integrated CRM system of individualized marketing actions that aims at:
 - increasing customers' attitudinal & behavioral loyalty through rewards & personalized relationships.
- Many American & European grocery retailers established LP's
 - Since creation *AAdvantage* in 1981, every sector is concerned (Retailing, Airlines, Car rental, Hotels,)
 - In France every grocery has one → imitation, less innovation
- More than 90% of European consumers belonged to at least one loyalty program in 2010 (+11% growth rate/year ACNielsen 2010).
- Based on the believe that 20% of store's clients realize 75% of its turnover (Reichheld 1996)



Number of loyalty cards in France

Sector	Program	N. cards (2009)
Grocery Retailing	Casino S'Miles Carrefour Leclerc	10 Mio 15 Mio 10 Mio
Specialised Retailing	FNAC KIABI Douglas Perfumery (Ger) Payback (Germany) Ikea (Germany) But Intersport	12 Mio 2 Mio 9 Mio 30 Mio 5 Mio 1 Mio 0.5 Mio
Transport& Hotel	Air France-KLM (world) American Airlines (woldr) Lufthansa (Germany)	15 Mio 30 Mio 15 Mio

The challenge of loyal customers





Mixed empirical evidence about LP's efficiency

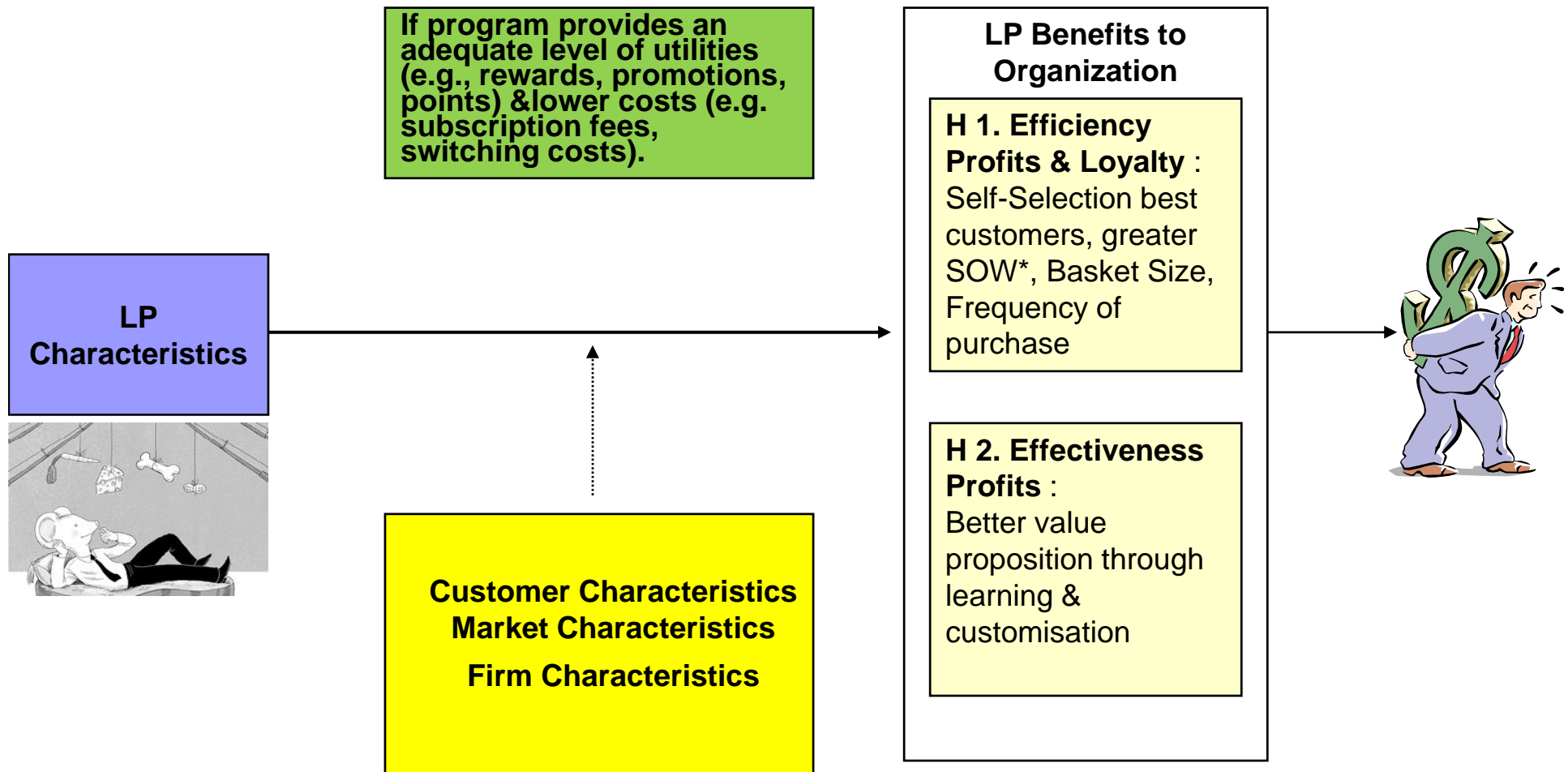
- LP's positively influence customers' choice of company, transaction values, resistance to counter-arguments, and retention (Nako (1997), Bolton et al. (2000), Lewis (2004), Taylor and Neslin (2005).
- Reward systems prevalent today are expensive to establish and weak changes in customers' purchase behavior do not justify such expenditures (Sharp and Sharp (1997), Reinartz (1999), Mägi (2003), Lewis 2007, Liu (2007), Leenheer et al. (2007)



Ambiguous results derive from limitations that hinder proper assessments of the effects of loyalty programs.

- None of these investigations had access to loyalty program enrollment dates
- Some studies only compare the impact on the short term (maximum: 1 year)

Conceptual Framework, Drivers of LP Effectiveness & Hypotheses





Methodology – The sample

- Match of *BehaviorScan* single source panel data (7 stores, covering 95% FMCG sales) with grocery retailer *Casino* (S1) store data (Angers, France): (2.500 consumers, 1 Mio. purchasing acts over 3 years).
- 546 S1 loyalty program members over a 156-week period (week 2/1998 - week 2/2001); 266 adoptors during 1998-2001.
- Use of individual weekly data to test the effect of the following behavioral variables: e.g. frequency of purchase, share-of-wallet (SOW), total & mean basket in the store, interpurchase time, consecutive store switchings, N of stores visited.
- 6/7 stores offer the same type of LP (cumulated points are exchanged against gifts)



Store description

Store	S1	S2	S3	S4	S5	S6	S7
Surface (m2)	8,900	5,300	9,000	9,400	5,200	2,000	1,400
Loyalty program	Yes	Yes	Yes		Yes	-	Yes
Launch loyalty program	1994	1994	1995		1995		1996
External partners program	Yes	Yes	No		No	-	No
Loyalty cardholders	546	301	744		264	-	383
Loyalty program penetration	19%	11%	30%		10%	-	16%
Market share	20%	12%	40%		11%	11%	6%



Methodology

- Adoption carte: Survival Analysis (Cox 1972): 266 adoptors 1998-01 & 1.884 S1 buyers who had not adopted by the end of the observation period.
 - Mean , total basket, SOW in S1; n consecutive switches to competitors' stores; n visited stores; n loyalty program memberships; distance S1 (number of km between the household and S1 and measured from the centroid of the store's zip code to the centroid of the household's zip code)
 - Risk function $h(t)$: probability event adoption card $h(t) = f(t) / 1-F(t) = f(t) / S(t)$.
 - $h(t)=h_0 e^{b_1 x_1+ b_2 x_2+\dots b_n x_n}$
 - If $h(t)$ high probability event adoption card is important → positif coefficients of the covariables b increase adoption probability

- Behavior change: MANOVA with repeated measures 3 trimesters (12 months) before and 4 trimesters (15 months) after enrollment; 266 adoptors 1998-01 who lived in S1's primary trading area (households less than 4 km from S1 & 930 S1 buyers who lived in the same area)

- Dirichlet Model:store penetration & purchase frequency (category and brand)

Self-selection effect

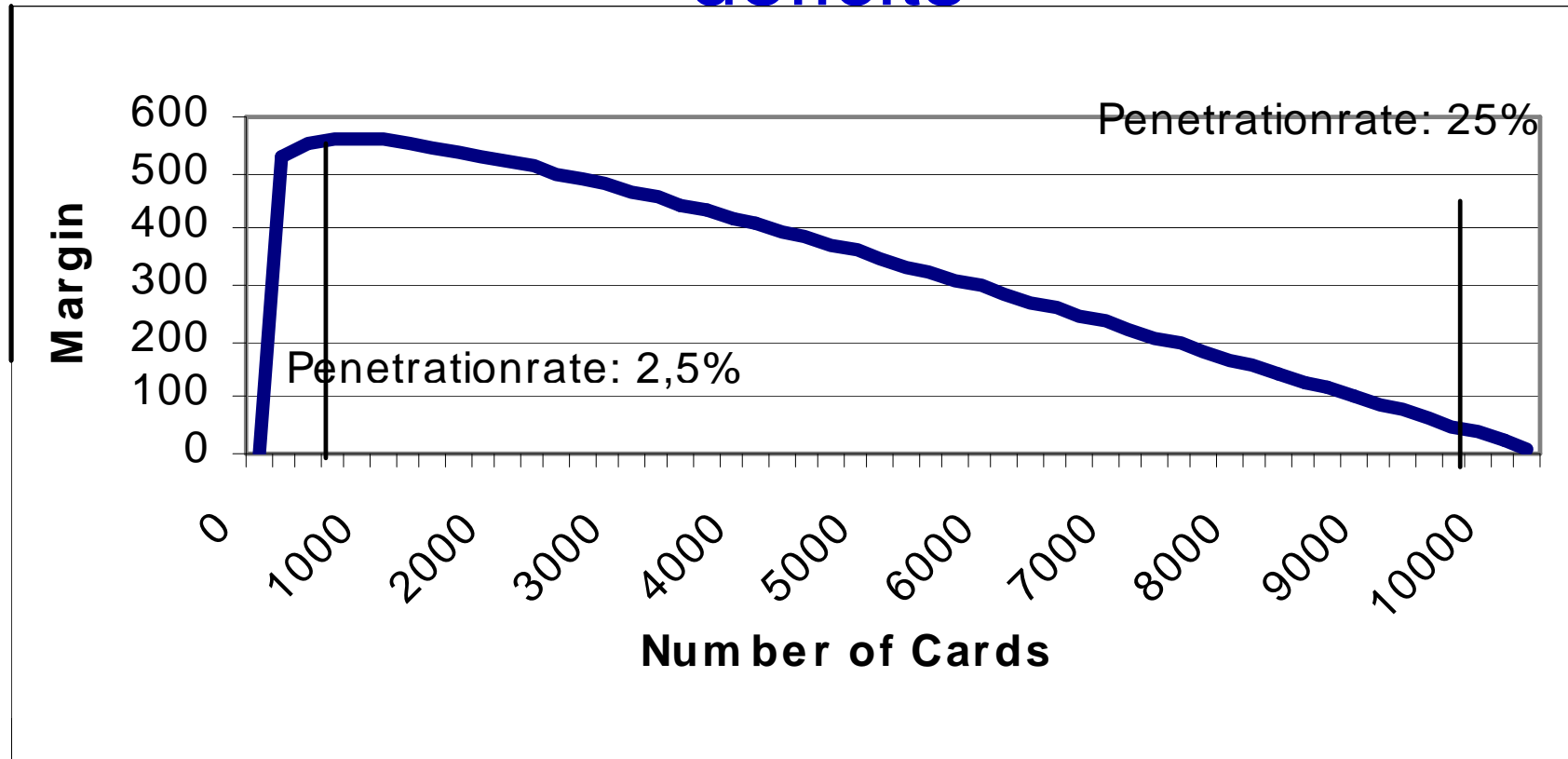
	b	SE	Wald
Store distance S1	-0.704**	0.002	5.77
Purchase frequency S1	0.36**	0.002	11.53
SOW S1	1.21**	0.226	28.55
Mean basket S1	0.25**	0.001	9.02
Consecutive store switches S1	0.010*	0.002	30.2
Number of visited stores	0.020 ns	0.001	4.55
Mean basket (grocery purchases)	0.176 ns	0.001	10.55
0 competitive loyalty card	-0.749**	1.416	7.99
1 competitive loyalty card	-0.320**	1.008	5.12
2 competitive loyalty cards	-0.224*	1.007	4.954
3 competitive loyalty cards	-0.118 ns	1.010	1.334
-2 initial log-likelihood	4135.6		
-2 final log-likelihood	3686.6	χ^2	246.35**

** $p < 0.01$; * $p < 0.05$; ns: non-significant.

Early adoptors are heavier purchasers than later ones

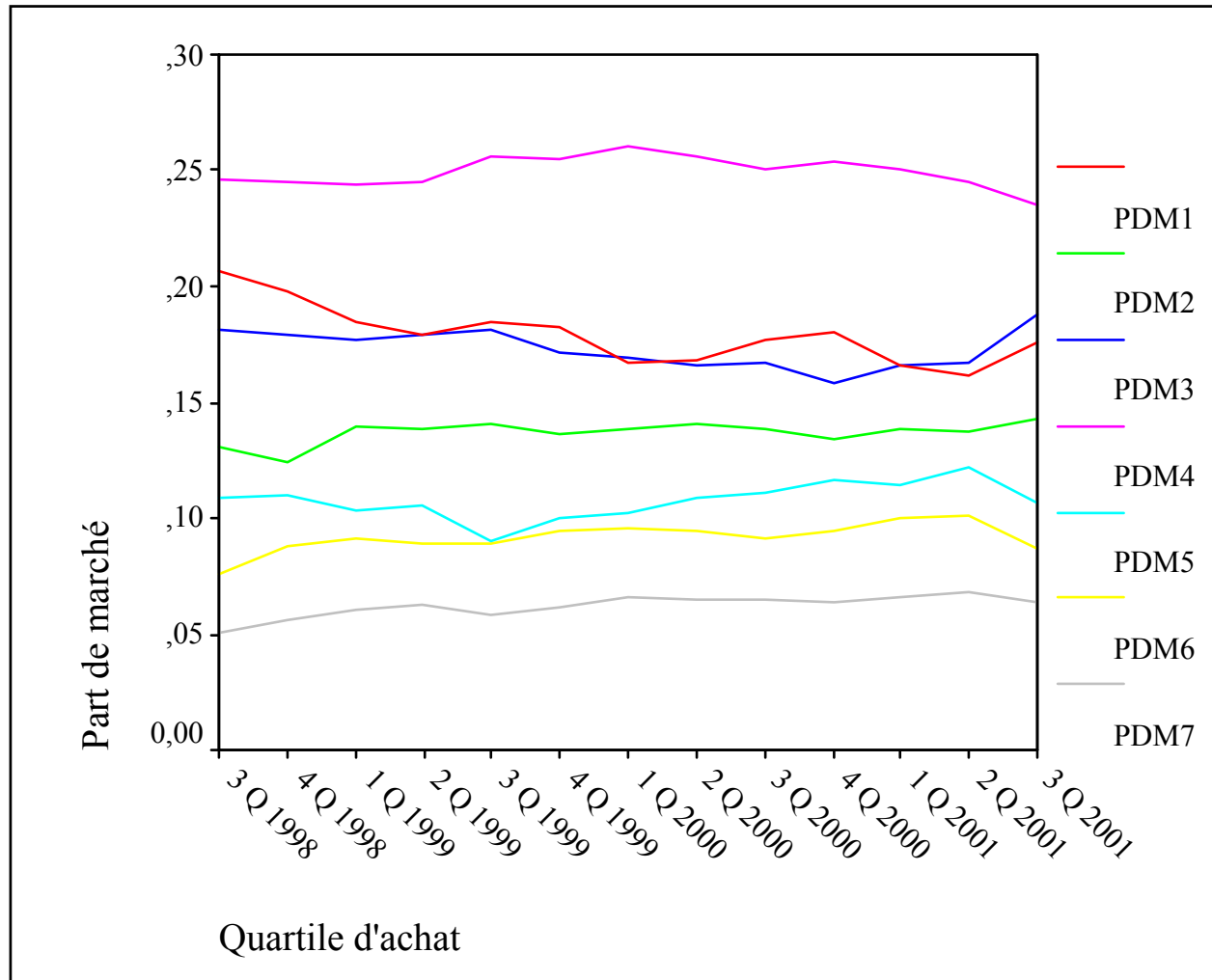
Year subscription	<1998	>=1998	P
Mean Basket S1	80 €	62 €	**
Total Basket S1	5.894€	3.337€	*
Share of requirement	74%	58%	**
Nb. Purchases S1	115	45	**
Inter Purch. Time	12	21	**
Switching	53%	78%	**
N visited stores	2,3	2,3	ns
Mean Basket Category	54	48	*

A massif card distribution leads to deficits



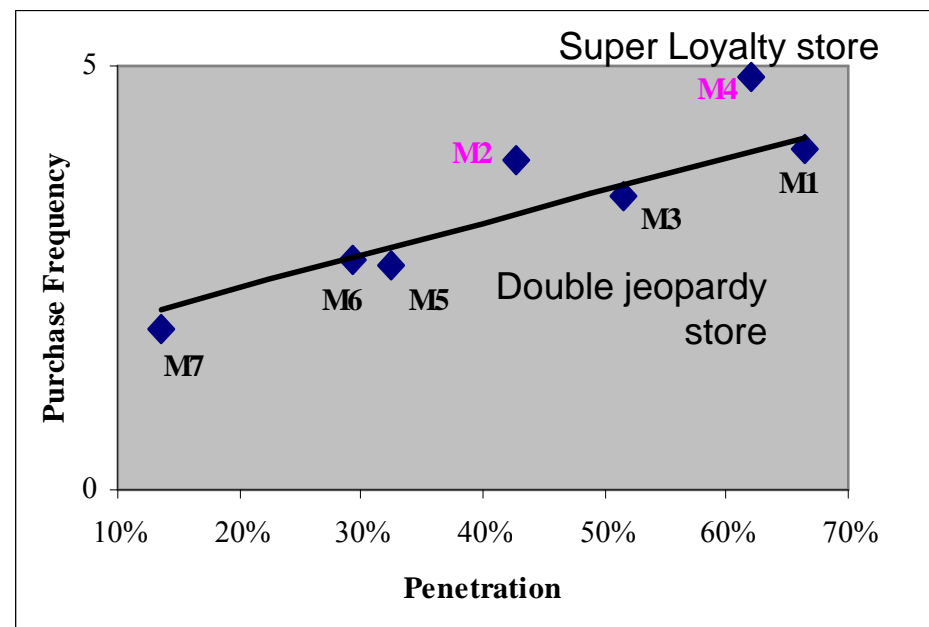
Selective distribution (consumers whose behaviours are likely to be modified by the use of the card)

No impact on market shares



Market leaders perform better than challengers - Double Jeopardy

- Double jeopardy (Ehrenberg 1988): small market share stores suffer because of two threats:
 - low share stores are visited by fewer customers than high share stores
 - among those who buy in the store, they visit it less often



Polygamous loyalty is the rule: no impact on Sole Buyers

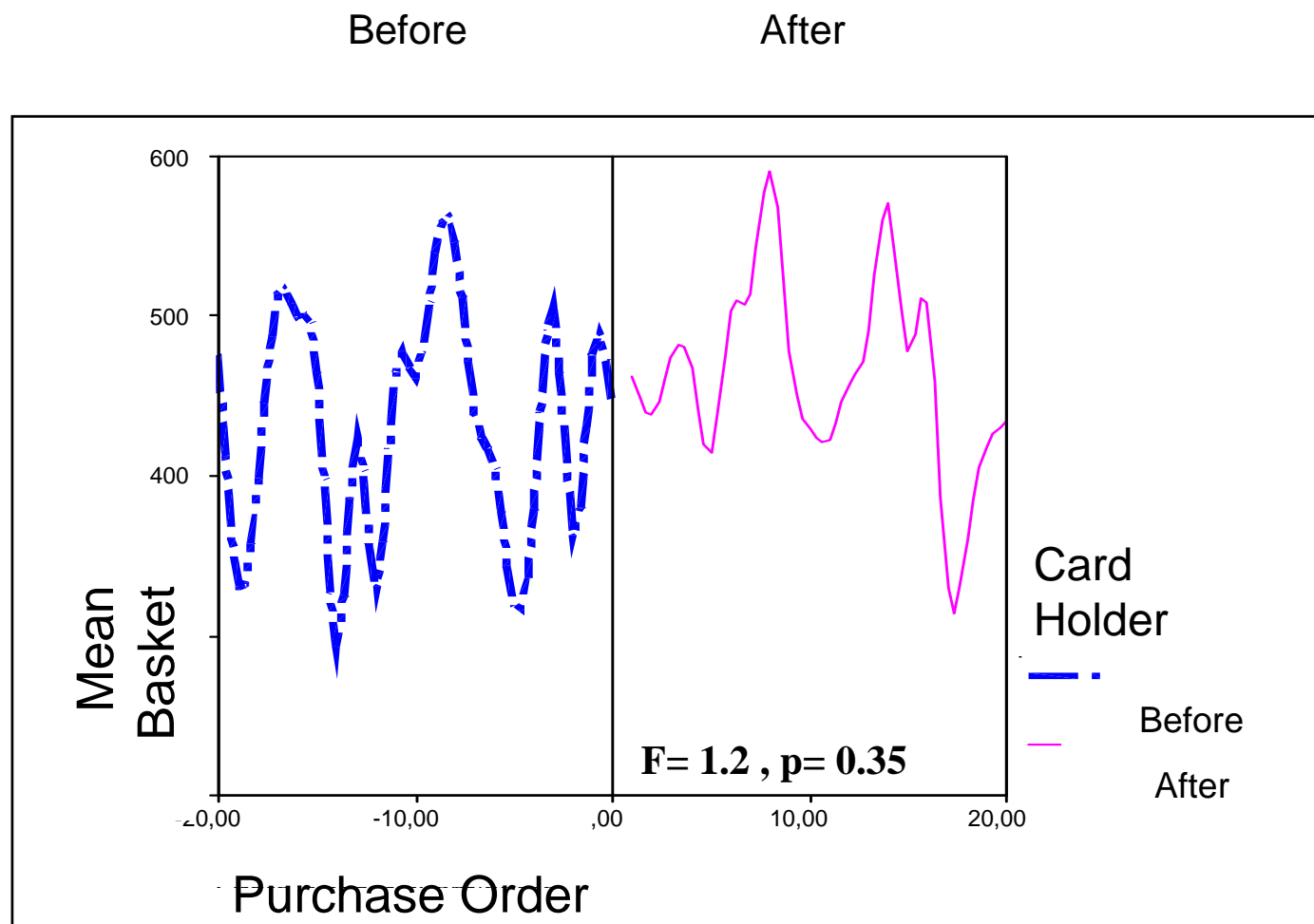
No Card Holder

Store	Sole Buyer
M1	1,6%
M4	2,0%
M3	1,7%
M2	1,7%
M5	0,7%
M6	0,6%
M7	0,4%

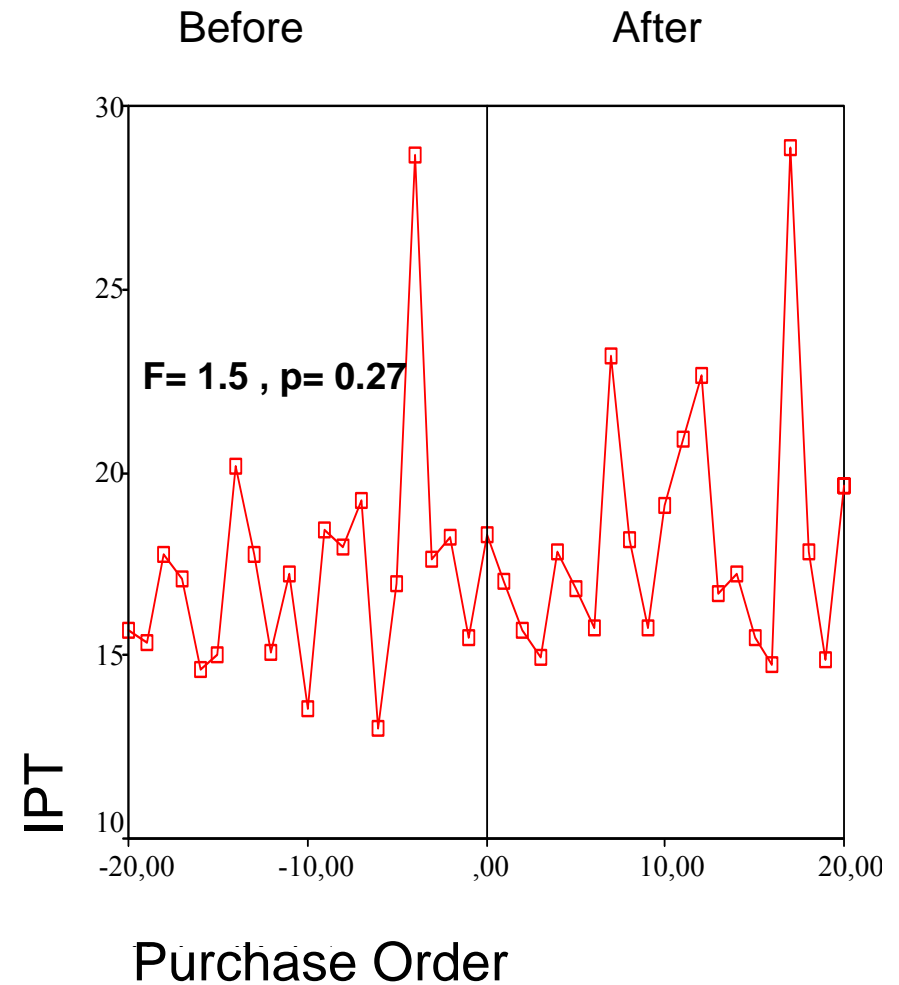
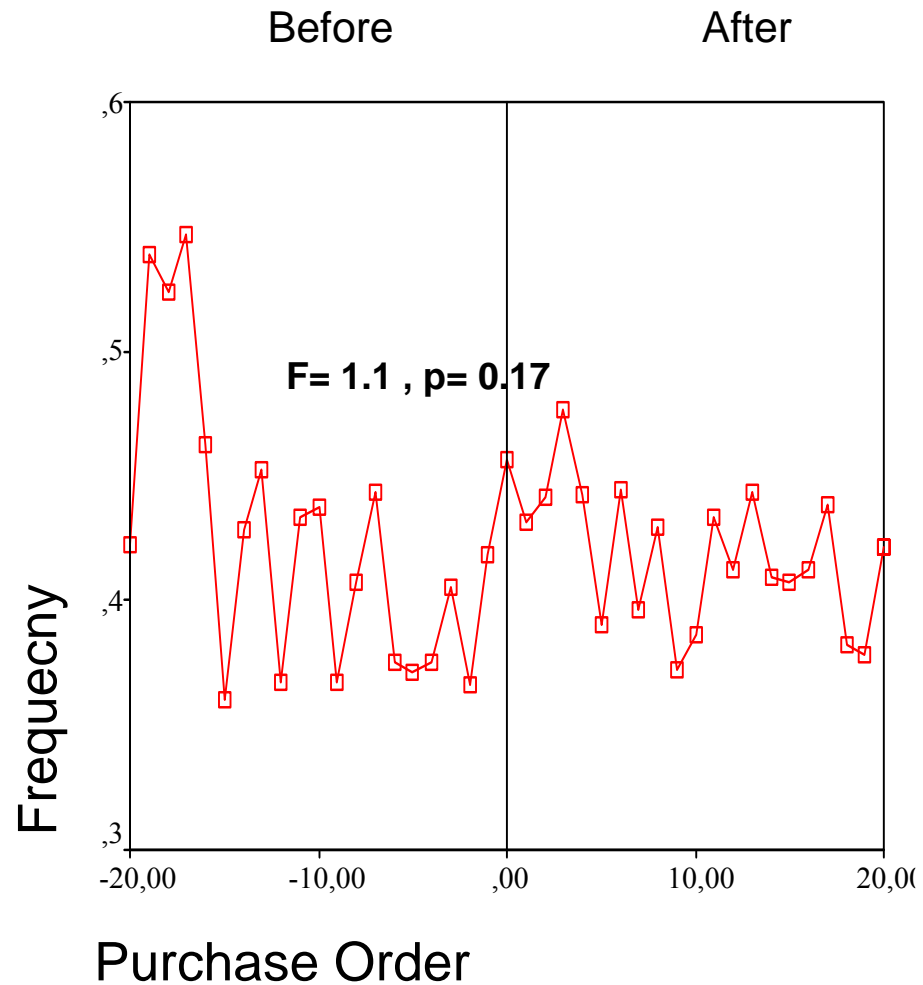
Card Holder

Store	Sole Buyer
M1	1,6%
M4	1,0%
M2	1,5%
M3	0,6%
M6	
M7	1,0%
M5	0,5%

Mean Basket



Purchase frequency & Inter-Purchase Time



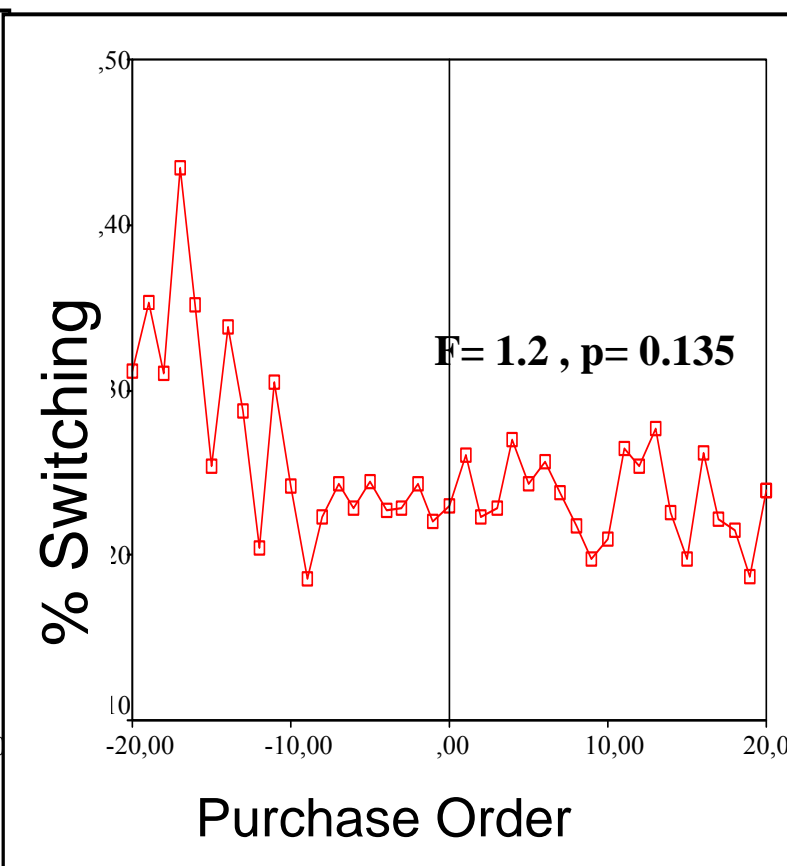
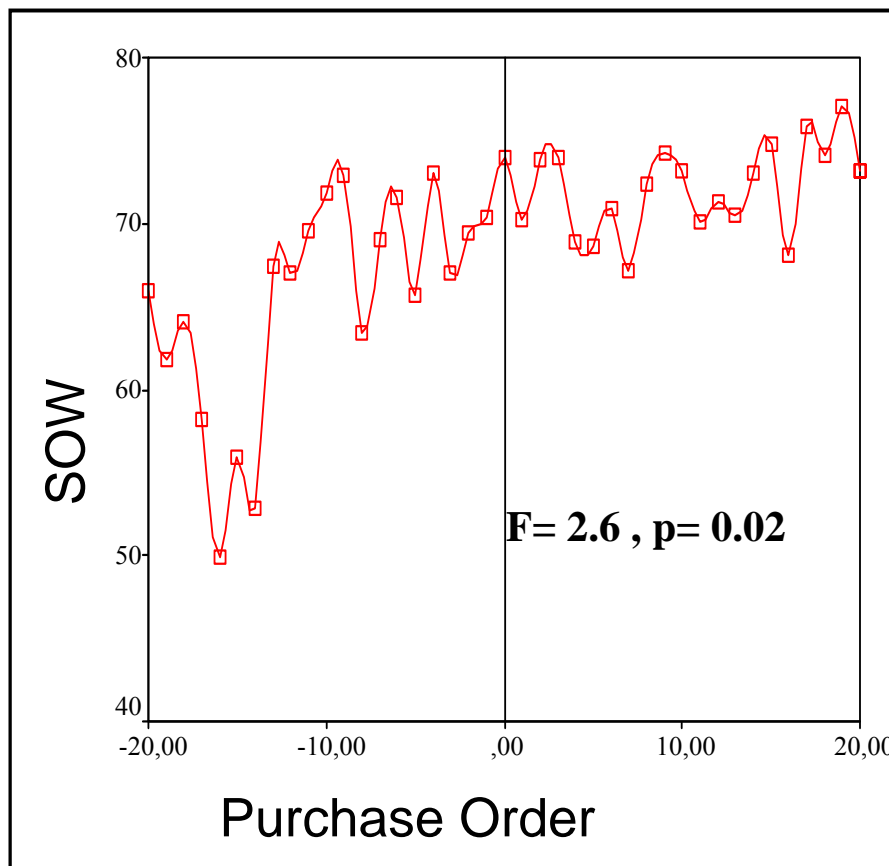
SOW, Store Switching

Avant

Après

Avant

Après





Discussion & empirical generalizations

- Short- run effects of the loyalty program → Support of previous research: Loyalty programs induce only weak, short term effects on purchase behavior after buyers join loyalty programs (Benavent et al. 2000; Leenheer et al. 2007; Mägi 2003; Meyer-Waarden 2002, 2007; Sharp & Sharp 1997; Meyer-Waarden & Benavent 2008).
- Most visible change occurred in first weeks after customers joined program, through short-term point pressure mechanism (Taylor & Neslin, 2005). Small changes drop back to baseline some weeks after enrollment. Customers switch to competitors with greater promotional activity (i.e., points pressure effect) and a retailer simply “borrows” any additional sales from competitors as switching costs are low (Hartmann & Viard 2008).
- As customers do not receive sufficient rewards for loyalty (i.e., utilities are higher than costs; use of promotional devices) → no rewarded behavior effect appears and customers’ repeat buying do not persist
 - No long-term behavioral reinforcement of behavioral learning (Rothschild & Gaidis 1981)
 - Creation program rather than store loyalty (Nunes & Drèze 2006)



What do customers and loyalty program managers think ?

Investigations:

- 3.000 French customers in all sectors (2007)
- 30 LP managers in all sectors (2007)



Effectiveness LP topic of debate

- High costs program management:
 - Estimated loyalty program expenditures grocery retailers > 100 Mio €/year
- Available customer data is proliferating for better customer segmentation & targeting → improved satisfaction & loyalty (H 2. Effectiveness Profits)
 - 14 % of retailers “always” use customer loyalty data (A.C. Nielsen 2005; Meyer-Waarden 2007)
 - 46% LP managers consider their LP’s as efficient (Meyer-Waarden 2007): weak added value, weak differentiation, weak usage of data
- Isomorphism (Powell & Di Maggio 1982) destroyed differentiation (Meyer-Waarden & Benavent, 2006).



Customers low perceived program value (Meyer-Waarden 2007; Sample: 3000 customers)

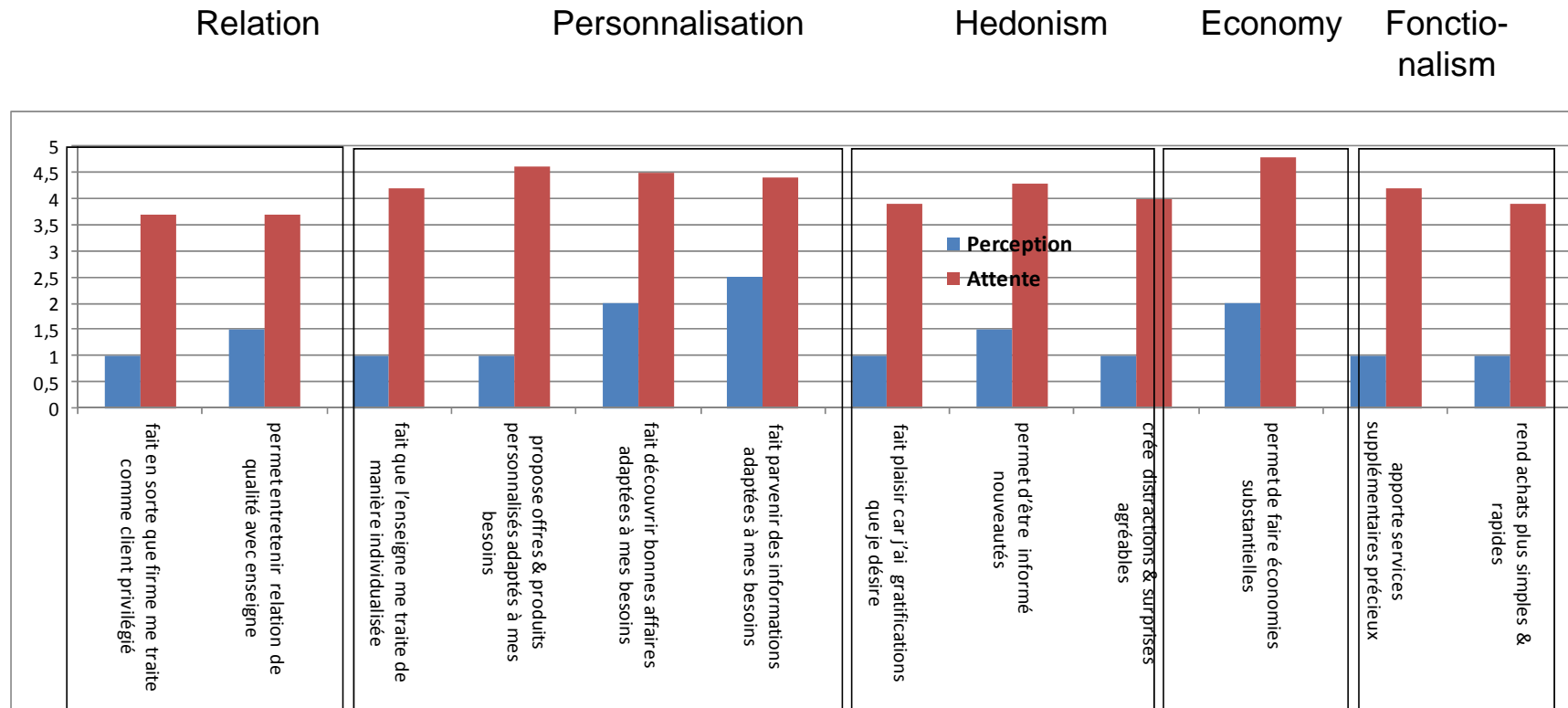
- 66% satisfied with **monetary value** (economies),
 - 31% satisfied with **functional value** (make purchases easier & quicker),
 - 40% satisfied with **informational value** (discovery new products, good deals etc.),
 - 31% satisfied with **hedonist value** (pleasure),
 - 30% valeur with **relational value** (establish relationship with brand, treatment as a privileged client, personalization).
-
- Only transport & car rental programs grant fonctionnal services , information &h donism

Reward Structure

	Car Rental	Airline	Telephone	Grocery Retailing	Petrol Station	Hotel	Book Store	Perfumery
Type Reward	Free WE Car Rental	Flights, Hotels, WE Car Rental	Free Units, Equipment	Catalog products	Catalog products	Free WE rooms	Vouchers	Service
Value Reward	100€	230€	25€	7€	6€	100€	10€	50€
Points/Purchase Amount	1p/0.5€	1p/0.4€	1p/0.15€	1p/0.8€	1p/8€	1p/0.16€	1p/0.1€	1p/1€
Necessary Points for Reward	3.000	20.000	15	1.000	600	10.000	4000	150
Necessary Purchases for Reward	450€	4600€	670€	760€	4600€	1.600€	400€	150€
Mean Basket in sector	70€	230€	30€	76€	46€	150€	15€	80€
Nnumber necessary Repeat Purchases	7	20	22	10	100	11	27	2
% Value Reward /Value Purchase	22%	5%	3%	1,0%	0.13%	6%	2.5%	33%

➤ 100 car petrol fills (1-2 years) & 4600€ for a Mug (value 6€).

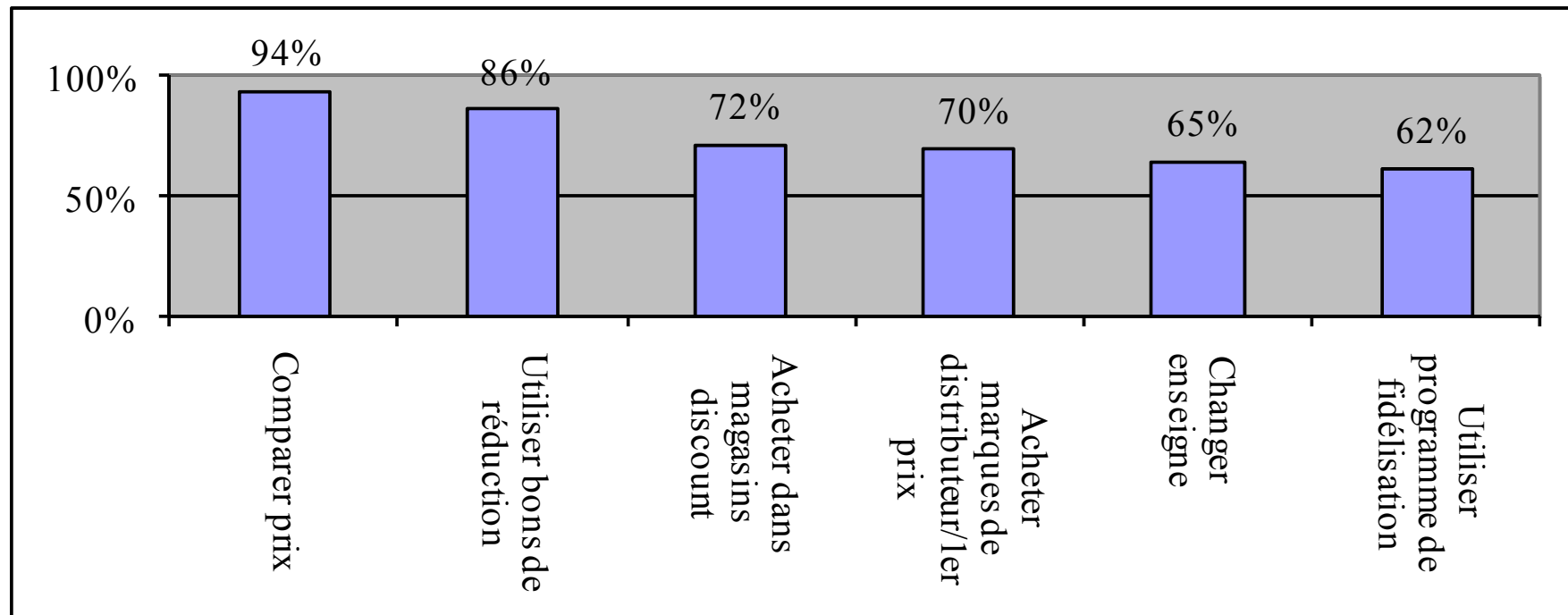
Discrepancy between expectations & perceptions




5: maximal score, 1 minimal score

Difference scores perceived value & expectation : positif → satisfaction, négatif → dissatisfaction

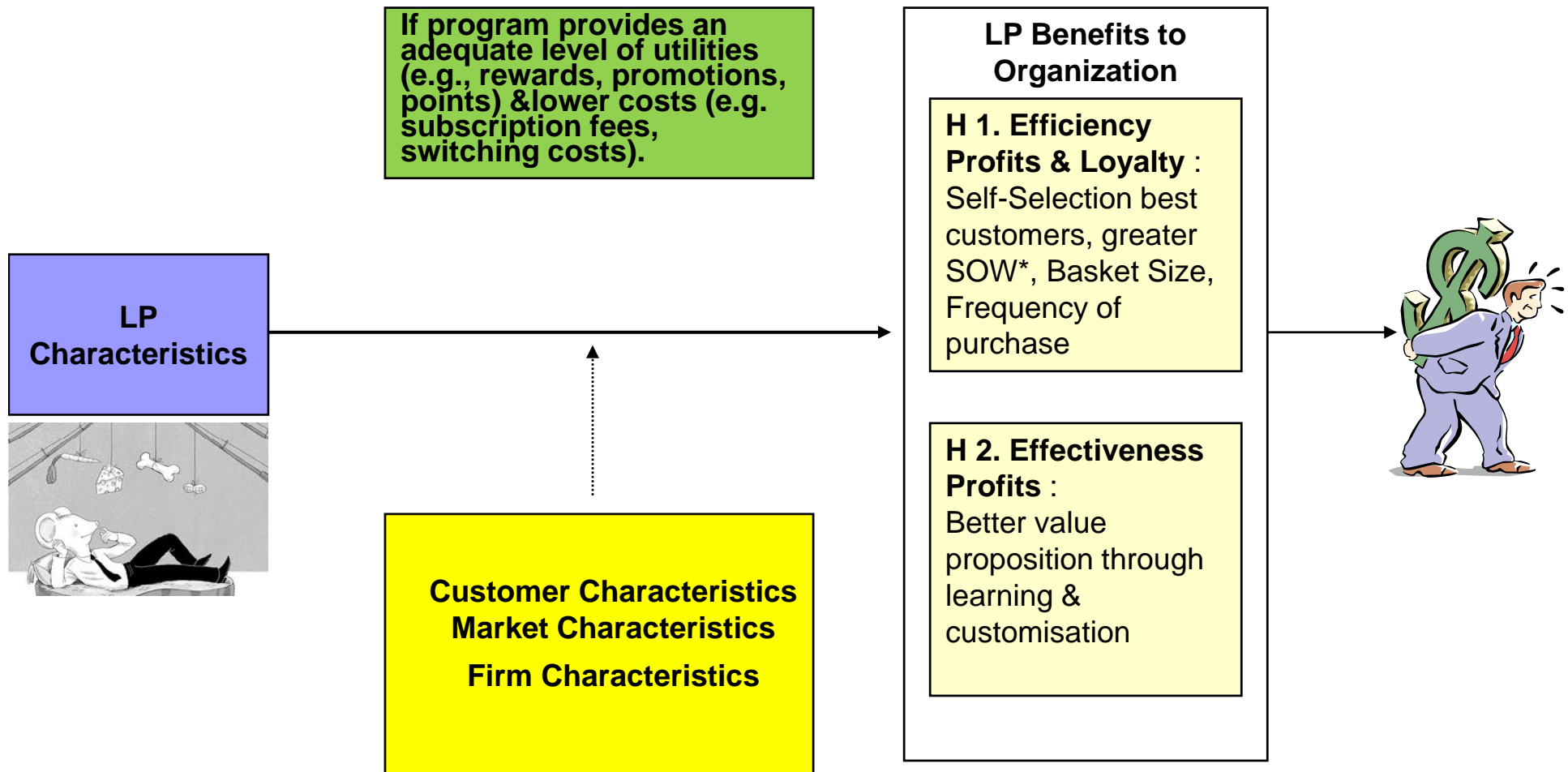
The best means to achieve good deals,...





H2 Effectiveness Profits
(Better value proposition
through learning &
customisation)

Conceptual Framework, Drivers of LP Effectiveness & Hypotheses





Purchase Orientations

- Consumers' mental predispositions toward purchase targets, based on experiences → explain motivations, preferences & behaviors (Stone 1954; Kahn & Schmittlein 1989)
 - Economic: save money;
 - Functional time optimising : save time;
 - Hedonist: discover new products or promotions, have pleasure;
 - Relational: meet people or sales staff;
 - Habit-Loyal Uncertainty avoiding : remain loyal to favorite brands/stores & gain reassurance about choices in order to minimise uncertainty

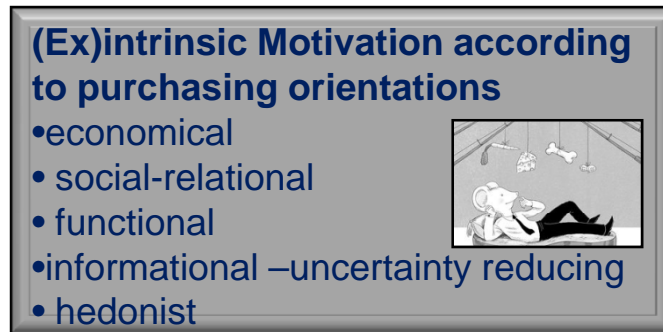
- These targets result in different purchase behaviours & sensitivity to marketing actions → link between purchase orientations & behaviour.
 - Shopping lists, research & comparison information (Use of Internet, brochures) vs. impulsive shopping,
 - Research variety vs. Brand Loyalty
 - Usage coupons, promotions & loyalty schemes
 - Research of relationships, privileges, contact with sales staff.
 - Use of priority check out or home delivery



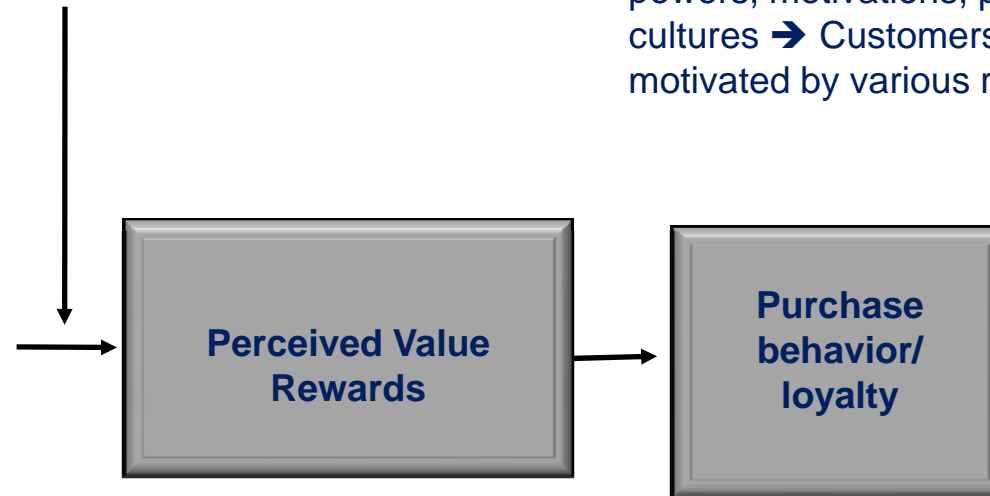
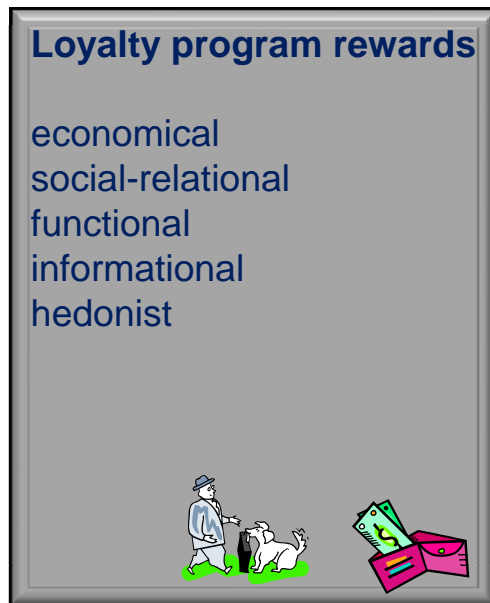
Self-Determination motivation theory (Deci 1971)

- Describes 2 main categories of motivations that explain differentiated behaviours
 - Intrinsic : people engage in activity for its own sake, without external incentive. Intrinsic rewards motivate individuals to act to obtain a benefit that matches their goals → positive influence motivation & behavior on the long term.
 - Extrinsic : extrinsic incentives motivate customers to act to obtain a benefit that sits apart from their target → zero or negative influence motivation & behavior (obtain a reward, avoid to feel guilty, approbation family) on the long term (only short term).
- Heterogeneous motivations depend on individual, contextual characteristics or purchase orientations.

Conceptual Model – LP usage is goal orientated & depends on purchase orientations



But: Disparities benefit perception & motivation due to interpersonal heterogeneity (social origins, buying powers, motivations, purchase targets & cultures → Customers differently motivated by various rewards.



Methodology-Data


- 2003-2007 in store/airport customer surveys :
 - 2 French grocery retailing chains (N= 3.132) ,
 - 1 international airline (N= 1.300),
 - 1 international perfumery chain (N= 1.214).

Programme	Hedonism	Relation	Economy	Functional	Information
Grocery Retailing	Games, sweepstakes, Exchange points against Spa	Personalisation at check-out, Mailing birthday & special events	Purchase vouchers, direct reductions at check-out (ratio value reward/spent money : 3%	Priority check-out, home delivery	Newsletter, personalised Mailings according to most bought products or categories
Airline	Games, sweepstakes, Exchange points against airline tickets, hotels	Personalisation & privileges on board for very good passengers, Mailing birthday & special events	Tickets. ratio value reward/spent money : 4.5%	Priority check-in, access lounges, Quota tickets available at the last moment	Newsletter, Mailings about news
Specialised Retailing	Games, sweepstakes, Exchange points against cosmetics, beauty services	Mailing birthday & special events	Purchase vouchers, direct reductions at check-out (ratio value reward/spent money : 3%	Service retouche	Newsletter, Mailings about news & personalised beauty advice




Methodology-Data

- Scales: 5 points Likert scales (1 “do not agree at all” – 5 “completely agree”)
 - Factor Analysis (Varimax), Confirmatory Factor Analysis & Structural Equation Modeling (AMOS)
 - Cronbach alphas > 0.7 → good reliability
 - 20 items Purchase orientations (Laaksonen 1993): 74% variance
 - 15 Items Frequent flier program’s rewards perceived value (Chandon et al., 2000): 73% variance
 - 6 Items Impact LP on purchase behavior & loyalty (Bruner et al 2005): 75% variance
 - Discriminant & convergent validity good for all scales.



Methodology – Estimation (1)

1. Estimation a base model (without purchase orientations or restrictions)
2. Estimation by taking different purchase orientations into account, fit by sector for the validation sample.
3. Estimation extended model to fit the holdout sample.



Methodology– Estimation (2)

- In all sectors & both extended models, indexes of adjustment are better than those for the base model.
- The GFI and AGFI $>.9$, RMSEA $<.05.$, Chi 2 (CMIN) decreases from the base model to the extended models, indicating a better fit of the more complex models that include purchase orientations.
- A Chi 2 difference test reveals no difference (CMIN, $p >.1$) between the validation and holdout samples; thus, the model displays measurement invariance.

Impact reward according to purchase orientations (grocery retailing)

Hypothesized relationships: rewards → gratification corresponding to intrinsic purchase orientation → PI/RCP.

Shopper	Budget-Optimizing		Social-Relational		Funct. Time-Optimizing		Uncertainty-Avoiding		Hedonist	
	Intensity	RCP	Intensity	RCP	Intensity	RCP	Intensity	RCP	Intensity	RCP
Relational	-.098/-.096ns	-.078/-.07ns	.725/.729**	.622/.63**	-.172/-.16*	-.162/-.14*	.094/.099*	.056/.049*	.225/.225*	.266/.29*
Economical	.741/.743**	.622/.629**	-.089/-.09ns	-.055/-.06ns	.085/.09ns	.086/.08 ns	.026/.028ns	.048/.050ns	.089/.089ns	.023/.027ns
Hedonist	.014/.02ns	.015/.011ns	.0435/.429ns	.0466/.47ns	-.024/-.02*	-.023/-.02*	.023/.021ns	.083/.089ns	.835/.835**	.810/.089ns
Functional	.045/.49ns	.032/.328ns	.021/.028ns	.086/.09ns	.966/.94**	.886/.876**	.040/.035ns	.051/.058ns	-.321/-.31*	-.311/-.32*
Informational	.253/.29**	.321/.322**	.143/.15ns/	.191/.18ns	.096/.091ns	.023/.021ns	.922/.96**	.91/.92**	.043/.046*	.011/.019*

Impact reward according to purchase orientations (perfumery)

Hypothesized relationships: rewards → gratification corresponding to intrinsic purchase orientation → PI/RCP.

Shopper	Budget-Optimizing		Social-Relational		Uncertainty-Avoiding		Hedonist	
	Intensity	RCP	Intensity	RCP	Intensity	RCP	Intensity	RCP
Relational	-.065/-.07ns	.075/.08ns	.374/.38**	.181/.19**	.023/.20*	.14/.19*	.204/.21*	.163/.17*
Economical	.669/.7**	.176/.18**	.021/.02ns	.201/.21ns	-.26/-.24ns	-.1/-.15ns	-.201/-.19ns	.183/.19ns
Hedonist	.843/.85ns	.369/.4ns	.042/.047ns	.028/.029ns	-.876/-.9ns	-.192/-.2ns	-.89/-.9**	.24/.27**
Functional	-0.02/-0.0ns	.338/.34ns	-.55/-.52ns	.249/.25ns	.05/.04ns	.825/.83ns	-.288/-.29ns	.264/.29ns
Informational	.46/.35**	.152/.16ns	.42/.43ns	.275/.28ns	.105/.11**	.04/.05**	.06/.07*	.251/.24*

Impact reward according to purchase orientations (airline)

Hypothesized relationships: rewards → gratification corresponding to intrinsic purchase orientation → PI/RCP.

Shopper	Budget Optimizing		Social-Relational		Uncertainty avoiding		Hedonist	
	PI	RCP	PI	RCP	PI	RCP	PI	RCP
Relational	.08	.2ns	.52**	.62**	.3*	.36*	.08*	.09*
Budg.-Optim.	.56**	.34**	.15ns	.18ns	.11ns	.23ns	.18ns	.29ns
Hedonist	.10ns	.21ns	.15*	.16*	.346ns	.23ns	.41**	.52**
Functional	.05ns	.07ns	.21ns	.23ns	.041**	.1**	-.03ns	-.01ns
Informational	.06ns	.05ns	.11ns	.13ns	.12**	.17**	.42*	.36*

** $p < .01$, * $p < .05$, ns: not significant. Purchase intensity (PI), resistance against counter-persuasion (RCP)

Impact personalised rewards on purchase behaviour according to purchase orientations

- 1. If reward corresponds to intrinsic motivation (related to purchase orientation) → positive impact on behaviour.
- 2. If reward corresponds to extrinsic motivation (not related to purchase orientation) → zero/negative impact on behaviour.

		Purchase Orientation				
		Econo- mical	Relatio- nal	Fonctio- nal	Habit- Loyal	Hedo- nistic
Reward	Ident. Relational	0	++	-	0	+
	Economical	++	0	0	0	0
	Hedonical	0	+	-	0	++
	Fonctional	0	0	++	0	0
	Distr.-Inform.	+	0	+	++	0




Discussion & theory building

- Customers develop different, coherent purchase behaviors (including loyalty program usage), because they are not intrinsically motivated by same targets.
- Customers' have different intrinsic or extrinsic purchasing orientations determine perceived benefits of loyalty program's reward gratifications & reinforce differently behaviors.
 - Intrinsic gratifications: motivate customers to act to obtain benefit that falls within target of purchase orientation and thus creates interest or pleasure in the task → positive intrinsic reinforcements, long-term impact on purchase behavior.
 - Extrinsic gratifications: motivate customers to act to obtain benefit that is separate from target of purchase orientation → no influence or only in the short term
- Challenge behaviorist belief applied in development of most loyalty programs.
 - Money & promotions to motivate people (conditioned behavior; Skinner 1976).
- Extrinsic rewards “buy” customers' intrinsic motivations to repurchase & encourage clients to focus narrowly on reward. Therefore, it erodes intrinsic interests and undermine feelings of control, which can interfere with consumers' motivations.



Managerial Implications

- Strong customer heterogeneity & absence of segmentation in existing loyalty schemes causes inefficiency
- Principal role of loyalty programs : identify & segment customers to improve resource allocations.
- Segmentation according to consumers' purchase orientations.
 - Thorough analysis of loyalty schemes' effects, at individual level, because consumer characteristics (e.g., shopping orientations) influence strength and direction of their impact on loyalty.
 - With such information, firms can undertake tailored strategies & incentives (e.g., promotions, rewards, communication, price discrimination) to appeal to different segments and retain their patronage.



Limitations & further research (1st investigation)

- The effectiveness of loyalty programs likely depends on the product category or sector. Our results are specific to retail grocers and probably cannot be generalized to other sectors (e.g., baby products, airlines, clothing).
- Convex reward systems & multitier programs might be more efficient in such contexts (Nunes & Dreze 2006).
- Further research in other areas should test how these and other factors influence program effectiveness, though such efforts might be difficult in industries that lack marketwide scanner-panel data on competitive purchasing.



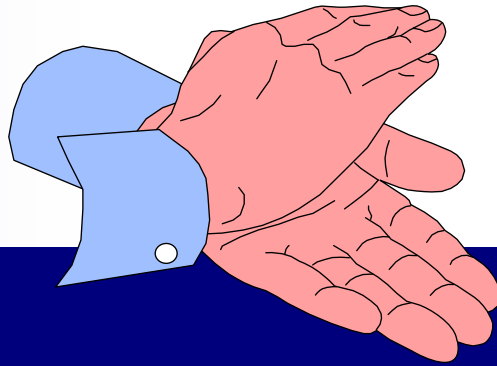
Limitations & further research (2nd investigation)

- Over-simplification classification purchasing motivations & rewards:
 - Difficulty to classify rewards exactly & uniquely to one category of gratification, because they might satisfy several purchase targets at the same time.
 - Exact hypotheses about intrinsic/extrinsic nature of a reward are difficult to formulate as purchase orientations are multidimensional and not hermetical
→ segment overlaps (i.e., hedonist-relational, hedonist-economical).
- Theory intrinsic motivation has been established for creative tasks. Thus the more an activity is complex, the more negative the impact of extrinsic rewards is. Intrinsic interest declines when rewarding somebody by extrinsic rewards (studies in pedagogies seem to confirm this hypothesis)
- Behaviorism still works in restrictive contexts for uninteresting, unpleasant tasks, as grocery shopping (McGraw & McCullers 1979)

Loyalty Programs: Shackle or Reward




- Grocery loyalty programs as they exist today fall short in terms of creating loyalty
- Loyalty programs focusing on incentives, deals, and promotions are often a very costly proposition for the firm
- *“LPs that are most likely to provide sustainable competitive advantage are those that leverage data obtained from consumers into more effective marketing decisions and thus result in true value creation for customers. Loyalty is likely to follow”*



Thank you for your
attention

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**Vector autoregressive (VAR)
persistence modeling to test the
long term effects of marketing
actions – The case of a loyalty
program**



Methodology – The sample

- Match of *BehaviorScan* single source panel data with grocery retailer store data (Angers, France)
- 546 loyalty program members over a 156-week period (week 2/1999 - week 2/2002)
- Use of weekly data to test the effect of the following behavioral variables: e.g. frequency of purchase, share-of-wallet (SOW), mean basket in the store
- To integrate the effect of the loyalty program, we considered the number of new loyalty cards distributed, which regularly increased over time.



Methodology - Persistence modeling to model long term impact of LP's (Dekimpe & Hanssens 1995)

- **Unit-root tests:** to investigate presence of **evolution** vs **stability** for purchasing behavior indicators
- **VAR** (Vector Auto Regressive) models, causality tests & Impulse response functions: To assess potential long-term impact of *N loyalty cards distributed at each period* and *Proportion of loyalty cards used during future periods* on *behavioral variables* (i.e. SOW, frequency of purchase, mean basket)
- VAR model estimation: JMulti [<http://www.jmulti.de>] (Lütkepohl & Krätzig 2008)



1. Unit Root Tests

- Rejection of unit-root null hypothesis as data is stationary (as overwhelming majority of demand patterns; Dekimpe et al. 2001).
- The loyalty indicators fluctuate around a fixed mean level
 - → no long-run evolving effects in data
 - → impact of past shocks is temporary, diminishes & loyalty indicators return to their preshock mean levels (i.e., stability).

But problem of unit-root tests:

- Indicate only potential for long-run marketing effectiveness
- Behavioral variables & LP membership are endogenous (i.e., explained by own past level & past levels of other endogenous variables).



2. VAR models to trace over-time impact of unexpected shock movements (1)

To assess potential l/t impact of marketing actions (i.e. LP)

- Estimation vector-autoregressive (VAR) model that captures evolution & interdependencies of multiple time series (“*SOW, Frequency of purchase, Mean basket, N of loyalty cards distributed at each period, Proportion of loyalty cards used during future periods*”).
- VAR models measure direct (immediate & lagged) responses to marketing actions and capture performance implications of complex feedback loops.



2. VAR models to trace over-time impact of unexpected shock movements (2)

- VAR models estimate baseline of each endogenous variable & forecast future values according to dynamic interactions of all jointly endogenous variables.

- Criteria for optimal number of lags :
 - Akaike information,
 - Hannan-Quinn,
 - Schwarz criteria,
 - Final prediction error.

2. VAR models (3) -Causality tests

Variable	Causal Hypothesis	Granger Causality	p	Instantaneous causality	p
Purchase frequency	New cards-> Behavior	0.908	0.489	1.706	0.426
	Prop. Buyer with Cards-> Behavior	3.149	0.005	16.392	0.000
Mean Basket	New cards-> Behavior	0.415	0.660	1.833	0.400
	Prop. Buyer with Cards-> Behavior	2.709	0.05	13.370	0.001
SOW	New cards-> Behavior	17.916	0.00	1.349	0.05
	Prop. Buyer with Cards-> Behavior	0.972	0.03	50.246	0.000

- The VAR causality tests indicate that we:
 - Do not reject the assumption of noncausality ($p > 0.05$) → “*N new loyalty cards distributed*” never influences purch. behavior (exception SOW, $p < 0.05$).
 - Reject the assumption of noncausality for purchasers who have a loyalty card ($p < 0.05$) → *effect of self-selection*. LP members are heavier customers who make a stronger contribution than do nonmembers, so when N cardholders increases, the behavioral loyalty indicators also increase with respect to demographics. This causality is ecological.



2. VAR forecast error variance decomposition (1)

- The tests imply that we might eliminate the **N of new cards** distributed from the VAR models (However, use of the variable as an exploratory target to obtain impulse response functions and to examine their shapes.
- We calculated VAR forecast error variance decomposition for purchase frequency, SOW, and mean basket, as well as the impact of the introduction of the loyalty card on the same purchasing behavior variables.

2. VAR forecast error variance decomposition (2)

	N New cards	Proportion exist. loyalty cardholders	Behavior	Mean	Std dev.	Unitary effect (UE)	UE /Mean
Buying frequency S1	0.00	0.24	0.76	26.059	6.913	0.160	0.61%
Mean Basket S1	0.00	0.14	0.86	393.908	29.867	1.187	0.30%
SOW S1	0.01	0.45	0.54	0.171	0.015	0.002	1.40%

- “N new loyalty cards” has a very weak direct effect on behavioral indicators → in line with results from causality tests.
- However: “Proportion of existing loyalty program members” represents substantial share of variance, particularly for SOW.



3. Impulse response functions

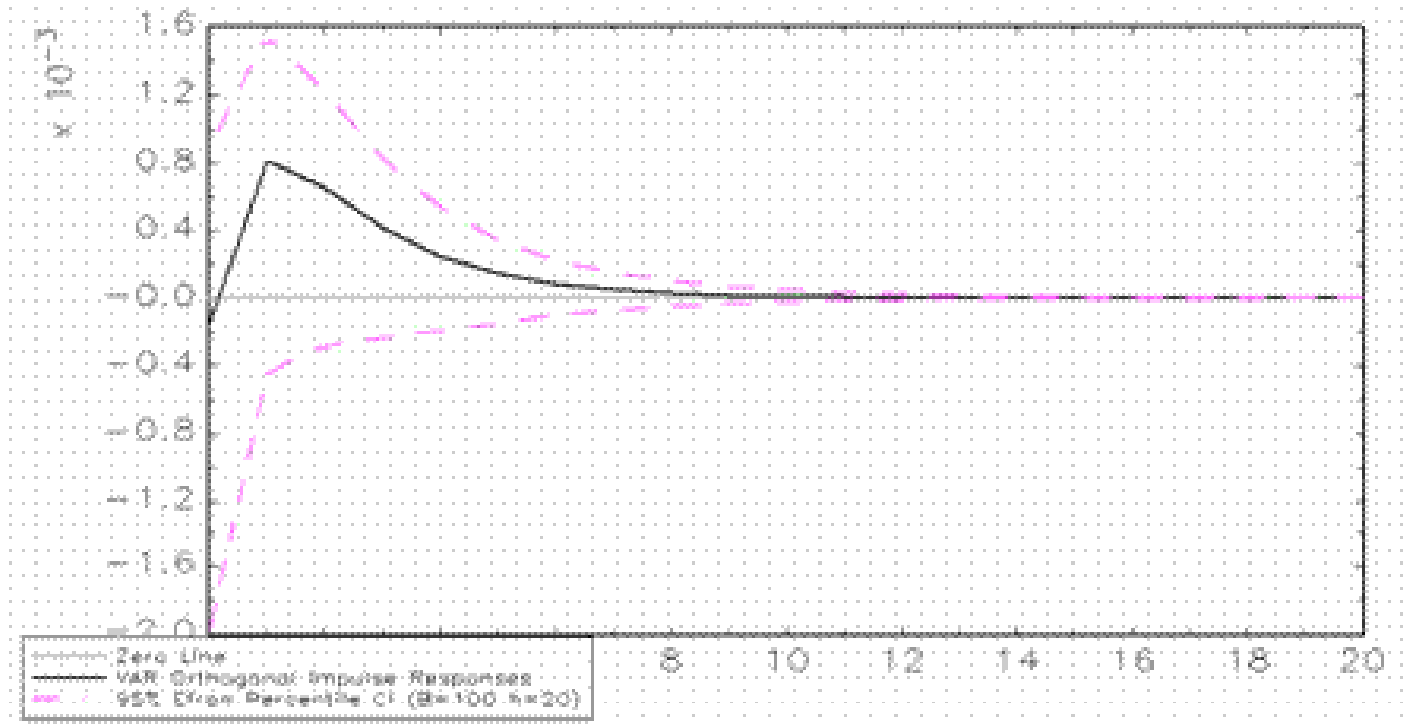
- If systematic tests of instantaneous causality & Granger tests are satisfactory, calculation:
 - baseline for endogenous variables
 - impulse response functions for unexpected shocks due to marketing variables (“SOW, Frequency of purchase, Mean basket, N of loyalty cards distributed at each period, Proportion of loyalty cards used during future periods”)



Impulse response functions

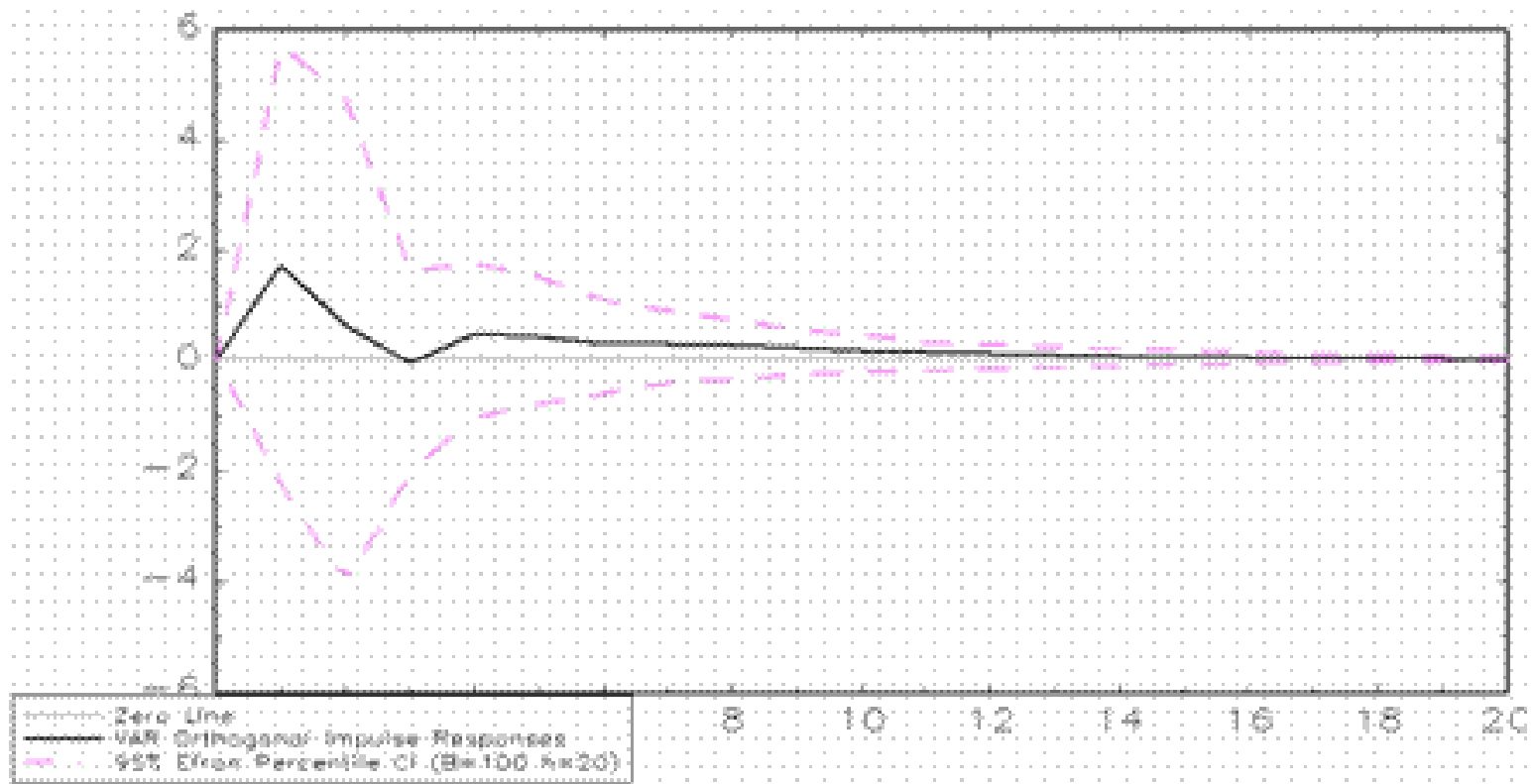
- Demand effects from “N of new cards distributed” on “Attraction of new customers to store, current customers’ increased purchases” are only weak (1%)
- Effects are not persistent & disappear quickly, after 3 weeks at most.
- In 95%: strongest increase 1.4% & weakest is 0.3%.

Mean Basket



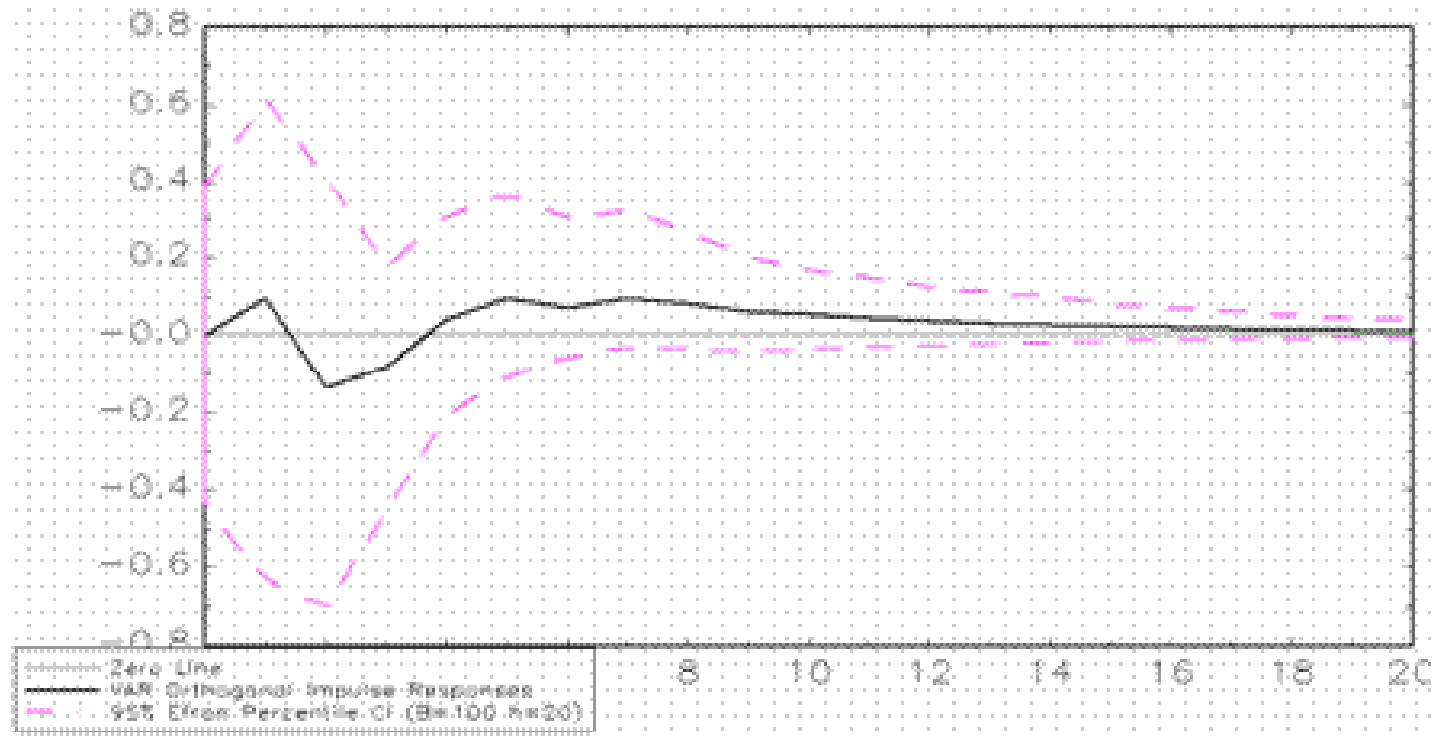
- Mean baskets increase at most by 0.8%.

SOW



- Impact is highest during 2nd week & increases by 1.4%.

Purchase Frequency



- Purchase frequency increases at most by 0.2%.



Modèle de survie

- variable aléatoire positive $T =$ durée d'adoption
- fonction de densité $f(t) = \lim[Pr(t < T < t+dt)]$ = densité de probabilité de subir l'événement de prendre carte de fidélité à un instant t .
- fonction de survie $S(t) = Pr(T \geq t) = 1 - F(t) = 1 - Pr(T < t)$ = probabilité cumulée de survie dans le temps de ne pas avoir encore adopté le programme.
- fonction de risque $h(t) = Pr(t \leq T \leq t+dt / T \geq t-1)$ = probabilité conditionnelle que l'événement « adoption de la carte » apparaisse à instant donné sachant qu'il n'est pas encore survenu. $h(t) = f(t) / 1 - F(t) = f(t) / S(t)$. Si $h(t)$ est élevé le risque d'adhésion est important.
- Pas de spécification fonction de risque paramétrique, suppose que risques sont proportionnels.
- $h(t) = h_0 e^{b_1 x_1 + b_2 x_2 + \dots + b_n x_n}$
- coefficients positifs covariables B diminuent probabilité de survie & augmentent probabilité d'adoption, coefficients négatifs diminuent cette dernière.

Intensity before/after subscription

No statistical significant impact on purchase intensity.

Trimester	-3	-2	-1	0	1	2	3
Mean Basket Card Holder	76€	74€	75€	80€	83€	79€	76€
Mean Basket No Card Holder	59€	62€	60€	60€	61€	59€	61€
p Time		ns	ns	ns	ns	ns	ns
p Time*Card		*	**	ns	ns	**	*
Purchase Frequency Card Holder	12	12	12	14	14	13	12
Purchase Frequency No Card Holder	6	6	6	6	6	6	7
p Time		**	**	ns	ns	ns	**
p Time*Card		**	**	ns	ns	ns	**
Interpurchase Time Card Holder	13	16	18	18	17	19	11
Interpurchase Time No Card Holder	24	42	47	51	53	61	71
p Time		**	**	ns	ns	ns	ns
p Time*Card		**	ns	ns	ns	ns	**

Loyalty before/after subscription

Slight statistical significant short term impact (from t0 until t+2) on SOR and Switching.

Trimester	-3	-2	-1	0	1	2	3
SOW Card Holders	59%	57%	59%	64%	65%	63%	62%
SOW No Card Holder	45%	48%	47%	47%	48%	44%	50%
P Time		**	**	**	ns	ns	ns
P Time*Card		**	ns	**	ns	ns	ns
Nb. Visited stores Card Holder	2,1	2,1	2,1	1.8	1.9	2,0	2,1
Nb. Visited stores No Card Holder	3,1	3,1	3,0	3,1	3,0	2,9	3,8
P Time		**	ns	**	**	ns	**
P Time*Card		**	**	ns	**	ns	**
% switching Card Holder	66%	70%	69%	58%	58%	68%	66%
% switching No Card Holder	61%	62%	62%	62%	61%	63%	61%
p Time		**	**	**	ns	ns	**
p Time*Card		**	**	**	ns	ns	**

BehaviorScan Test Market -

