

Use of Conjoint Analysis to Assess Consumer Preferences in Biomedical and Behavioral Interventions

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Outline

- Conjoint analysis (CA) introduction
- Steps involved in CA
- Applications of CA examples
- Applications in mobile phone interventions
- Concluding remarks

In the market for a new car

Which do you prefer?

Engine: 190 hp

280 hp



In the market for a new car

Which do you prefer?

Fuel Economy:

24 city/ 35 highway 

18 city/ 25 highway

In the market for a new car

Which do you prefer?

Car capacity:

4 passengers

6 passengers



In the market for a new car

Which do you prefer?

Price: \$19, 500



\$28, 200

In the market for a new car

Which car do you prefer?



Engine	190 hp	290 hp
Fuel	24 / 35	17 / 24
Capacity	4 passengers	6 passengers
Price	\$ 19,500	\$ 28,200

In the market for a new car

Which car do you prefer?



Engine

- 190 hp

+ 290 hp

Fuel

+ 24 / 35

- 17 / 24

Capacity

- 4 passengers

+ 6 passengers

Price

+ \$ 19,500

- \$ 28,200

Conjoint Analysis

- CA: popular marketing research technique used to determine what features a new product should have
- Gaining popularity in assessing consumer acceptability of health-related services/programs
- Instead of presenting a series of disparate single item feature, we present a 'bundle' of features, thus requiring decisions regarding the relative importance of different features
- More closely approximates real-world decision making
- Allows for the computation of the individual utilities underlying consumer preferences

Steps in Conjoint Analysis

- Develop product attributes
- Generate conjoint scenarios
- Administer scenarios (individual or group)
- Data analysis

Step 1. Develop product attributes

- Workgroups (experts, community advisory groups)
- Focus groups (potential consumers)
- Key informant interviews (in-depth interviews)
- Determine attributes and assign levels for each attribute

Step 2. Generate conjoint scenarios

- Example: HIV vaccine acceptability
- Seven dichotomous attributes
- $2^7 = 128$ possible scenarios
- Fractional factorial orthogonal design yielded 8 scenarios (estimate main effects only)

Experimental Design for Conjoint Analysis: Hypothetical HIV Vaccines

Hypothetical Vaccines	Efficacy	Cross-Clade Protection	Side Effects	Duration of Protection	Route	Number of Doses	Cost
1	50%	multiple types	none	10 yrs	injection	3	\$10
2	95%	multiple types	none	10 yrs	oral	1	\$50
3	50%	one type	minor	10 yrs	injection	1	\$50
4	95%	one type	minor	10 yrs	oral	3	\$10
5	50%	one type	none	lifetime	oral	3	\$50
6	95%	one type	none	lifetime	injection	1	\$10
7	50%	multiple types	minor	lifetime	oral	1	\$10
8	95%	multiple types	minor	lifetime	injection	3	\$50

Note. Preferred features of attributes are highlighted in yellow and non-preferred features are highlighted in blue
 Minor side effects = temporary body aches, skin rash and fever.

Solutions ---- Analysis ---- Design of Experiments --- ADX: Two-Level Design Specifications

Design List Options

Number of factors: 7

Show designs of type:

- Fractional factorial designs
- Plackett-Burman designs
- Show blocked designs

Design Details...

Factors	Runs	Type	Resolution: Estimable Effects	Blocks	Block Size
7	8	1/16 Fraction	3:Main Effects Only	1	8
7	16	1/8 Fraction	4:Some 2FI	1	16
7	32	1/4 Fraction	4:Some 2FI	1	32
7	64	1/2 Fraction	7:All 2FI	1	64
7	128	Full Factorial	All Effects	1	128

Design Information | Design Listing | Confounding Rules | Alias Structure

Uncoded Design

	X1	X2	X3	X4	X5	X6	X7
1	-1	-1	-1	-1	1	1	1
2	1	-1	-1	1	-1	1	-1
3	-1	1	-1	1	1	-1	-1
4	1	1	-1	-1	-1	-1	1
5	-1	-1	1	-1	-1	-1	-1
6	1	-1	1	1	1	-1	1
7	-1	1	1	1	-1	1	1
8	1	1	1	-1	1	1	-1

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- Getting Started with the SAS® 9.2 ADX Interface for Design of Experiments

<http://support.sas.com/documentation/cdl/en/adxgs/60376/PDF/default/adxgs.pdf>

`%MktEx Macro: creates efficient factorial designs`

```
%mktex(2 2 2 2 2 2 2, n=8)
```

```
%mktlab(vars=efficacy duration protection doses route  
sideeffects cost, out=sasuser.design)
```

```
%mkteval;
```

```
proc print data=sasuser.design;
```

```
run;
```

<http://support.sas.com/techsup/technote/mr2010mktex.pdf>

Output

Obs	efficacy	duration	protection	doses	route	sideeffects	cost
1	2	1	1	1	1	1	1
2	1	1	2	1	2	1	2
3	1	1	1	2	2	2	1
4	1	2	2	2	1	1	1
5	2	1	2	2	1	2	2
6	1	2	1	1	1	2	2
7	2	2	2	1	2	2	1
8	2	2	1	2	2	1	2

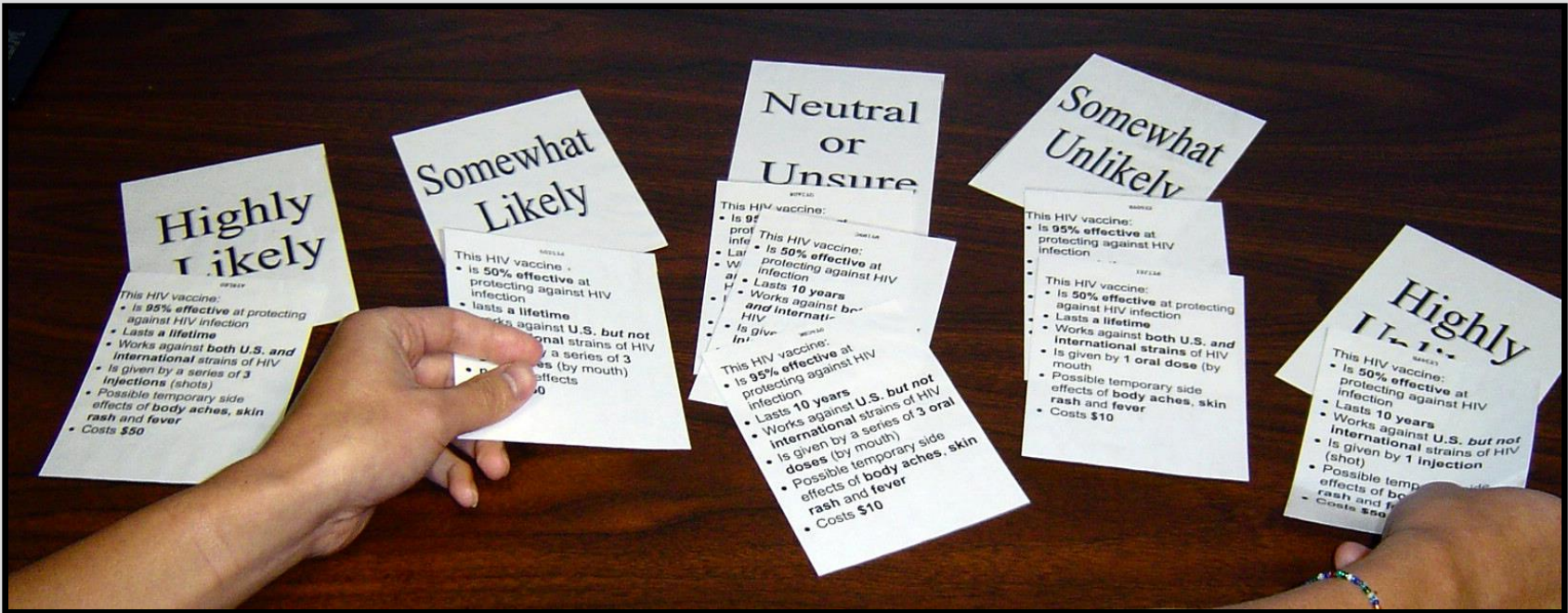
Step 3. Administer conjoint scenarios

- Face-to-face interviews using hand cards
 - Participants presented with eight cards and asked to rate acceptability for each scenario
- Group format following focus group
 - Participants were seated far enough so that they can rate independently.
 - Facilitators would float to provide assistance when needed

ประสิทธิภาพ:	99%
ผลข้างเคียง:	ไม่มี
ระยะเวลาป้องกัน:	10 ปี
จำนวนครั้งที่ได้รับ:	1
วิธีการรับ:	ฉีด
จำนวนเชื้อที่ป้องกัน:	ชนิดเดียว
ราคา:	0

ประสิทธิภาพ:	50%
ผลข้างเคียง:	ไม่มี
ระยะเวลาป้องกัน:	10 ปี
จำนวนครั้งที่ได้รับ:	4
วิธีการรับ:	รับประทาน
จำนวนเชื้อที่ป้องกัน:	ชนิดเดียว
ราคา:	\$250

- This HIV vaccine:
- Is **50% effective** at protecting against HIV infection
 - Lasts **10 years**
 - Works against **U.S. but not international** strains of HIV
 - Is given by **1 injection** (shot)
 - Possible temporary side effects of **body aches, skin rash and fever**
 - Costs **\$50**



Step 4. Data analysis

For each respondent, a multiple regression model is fit to their acceptability scores Y_i for the eight hypothetical vaccines, $i = 1, \dots, 8$; the seven vaccine attributes A_p , $p = 1, \dots, 7$, serve as independent variables in the model, categorized as preferred (1) or not preferred (0). The mathematical representation of the model is:

$$Y_i = \beta_0 + \sum \beta_p A_p + \varepsilon_i$$

where \sum is a summation over the seven regression coefficients β_p and attributes and ε_i is a residual error term. The regression coefficient for each vaccine attribute (e.g., efficacy, cost) in the model is the impact score of the attribute on vaccine acceptability for the individual respondent.

Step 4. Data analysis

The mathematical representation of the impact score for each attribute simplifies to the net difference in mean acceptability between the four scenarios with the preferred value and the four scenarios with the non-preferred value.

Likelihood of Adoption by Hypothetical HIV Vaccines (n=143)

Vaccine #	Likelihood of Vaccine Adoption Mean (SD)	Efficacy	Cross-Clade Protection	Side Effects	Duration of Protection	Route	Number of Doses	Cost
2	82.2 (31.8)	95%	multiple types	none	10 yrs	oral	1	\$50
6	73.3 (37.8)	95%	one type	none	lifetime	injection	1	\$10
8	73.1(35.0)	95%	multiple types	minor	lifetime	injection	3	\$50
4	56.6 (36.1)	95%	one type	minor	10 yrs	oral	3	\$10
1	55.6 (35.0)	50%	multiple types	none	10 yrs	injection	3	\$10
7	54.0 (35.6)	50%	multiple types	minor	lifetime	oral	1	\$10
5	51.7 (37.7)	50%	one type	none	lifetime	oral	3	\$50
3	33.2 (35.0)	50%	one type	minor	10 yrs	injection	1	\$50
Mean Impact Score		22.68	12.53	11.48	6.12	2.33	1.43	-0.20

Note. Preferred features of attributes are highlighted in yellow and non-preferred features are highlighted in blue.

SD = Standard deviation. Minor side effects = temporary body aches, skin rash and fever.

* Impact scores highlighted in red: $p < .05$ for the one-sample two-tailed t-test.

Experimental Design for Conjoint Analysis: Hypothetical Pre-Exposure Prophylaxis (PrEP)

PrEP	Cost	Efficacy	Side Effects	Duration of Administration	Frequency	Location	Person dispensing PrEP
1	\$10	75%	none	1 year	everyday	General clinic	Dr/nurse
2	\$250	95%	none	1 year	before sex	General clinic	Pharmacist
3	\$250	75%	minor	1 year	before sex	HIV clinic	Dr/nurse
4	\$10	95%	minor	1 year	everyday	HIV clinic	Pharmacist
5	\$250	75%	none	10 yrs	everyday	HIV clinic	Pharmacist
6	\$10	95%	none	10 yrs	before sex	HIV clinic	Dr/nurse
7	\$10	75%	minor	10 yrs	before sex	General clinic	Pharmacist
8	\$250	95%	minor	10 yrs	everyday	General clinic	Dr/nurse

Note. Preferred features of attributes are highlighted in yellow and non-preferred features are highlighted in blue
Minor side effects = dizziness/nausea

Acceptability of hypothetical PrEP in order of decreasing acceptability (n=45)

PrEP #	PrEP Acceptability Mean (SD)	Cost	Efficacy	Side Effects	Duration of Administration	Frequency	Location	Person dispensing PrEP
6	82.6 (28.1)	\$10	95%	none	10 yrs	before sex	HIV clinic	Dr/nurse
4	64.5 (37.1)	\$10	95%	minor	1 yr	everyday	HIV clinic	Pharmacist
1	59.3 (36.6)	\$10	\$75	none	1 yr	everyday	General clinic	Dr/nurse
2	50.6 (33.0)	\$250	95%	none	1 yr	before sex	General clinic	Pharmacist
8	42.4 (38.0)	\$250	95%	minor	10 yrs	everyday	General clinic	Dr/nurse
7	41.3 (32.2)	\$10	\$75	minor	10 yrs	before sex	General clinic	Pharmacist
5	34.3 (34.9)	\$250	\$75	none	10 yrs	everyday	HIV clinic	Pharmacist
3	19.8 (28.6)	\$250	\$75	minor	1 yr	before sex	HIV clinic	Dr/nurse
Mean Impact Score		25.15	21.37	14.68	-1.60	-1.60	-1.89	-3.34

Note. Preferred features of attributes are highlighted in yellow and non-preferred features are highlighted in blue.
SD = Standard deviation. Minor side effects = temporary body aches, skin rash and fever.
Impact scores highlighted in red: $p < .05$ for the one-sample two-tailed t-test.

Experimental Design for Conjoint Analysis: Willingness to test for HIV among MSM in Los Angeles

HIV testing Scenarios	Counseling	Location	Price	Sample Collection	Timeliness of results	Results Given	Privacy
1	brochure w/ call	clinic	free	prick finger	1-2 weeks	by phone	confidential
2	talk to a counselor	home	free	prick finger	immediately	by phone	anonymous
3	talk to a counselor	clinic	\$50	prick finger	immediately	in person	confidential
4	brochure w/ call	home	\$50	prick finger	1-2 weeks	in person	anonymous
5	talk to a counselor	clinic	free	blood	1-2 weeks	in person	anonymous
6	brochure w/ call	home	free	blood	immediately	in person	confidential
7	brochure w/ call	clinic	\$50	blood	immediately	by phone	anonymous
8	talk to a counselor	home	\$50	blood	1-2 weeks	by phone	confidential

Note. Preferred features of attributes are highlighted in yellow and non-preferred features are highlighted in blue

Willingness to Test (WTT) for HIV Scores among MSM in order of decreasing WTT score (n=75)

Mean WTT Score	Location	Price	Sample Collection	Timeliness of Results	Privacy	Results Given	Counseling
6	home	free	blood	immediate	anonymous	by phone	talk to a counselor
79.3	home	free	prick finger	immediate	confidential	in person	brochure w/ call
59.7	clinic	free	blood	1-2 weeks	confidential	by phone	brochure w/ call
51.7	clinic	free	prick finger	1-2 weeks	anonymous	in person	talk to a counselor
38.7	clinic	\$50	blood	immediate	confidential	in person	talk to a counselor
37.7	clinic	\$50	prick finger	immediate	anonymous	by phone	brochure w/ call
36.7	home	\$50	prick finger	1-2 weeks	confidential	by phone	talk to a counselor
32.3	home	\$50	blood	1-2 weeks	anonymous	in person	brochure w/ call
Mean Impact Score	31.42	13.91	10.25	3.08	0.42	-1.42	-3.08

Note. Preferred features of attributes are highlighted in yellow and non-preferred features are highlighted in blue. Impact scores highlighted in red: $p < .05$ for the one-sample two-tailed t-test.

CA Application in Mobile Phone use in Behavioral Research

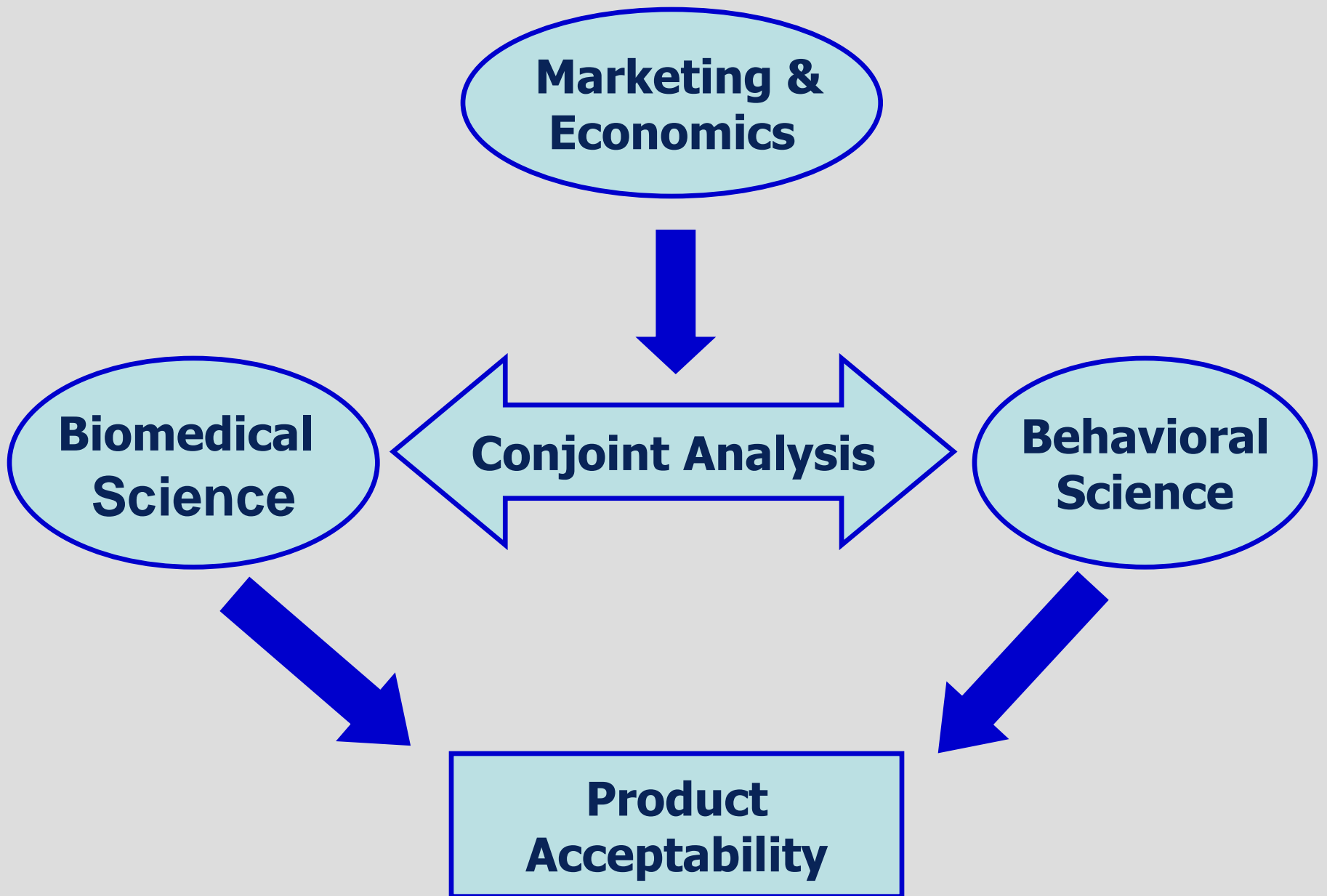
- Present participants with hypothetical mobile phone app with various attributes
 - Prompts (2 times a day vs. 15 times a day)
 - Prompts (time-based vs. location-based)
 - Real time feedback (yes vs. no)
 - Customizable reminders
 - Stress button
 - # of widgets on the screen

Other types of CA

- Adaptive Conjoint Analysis (ACA):
 - Adapts the interview for each respondent
 - In the first phase, find out the values to focus on those areas of importance
- Choice-Based Conjoint Analysis (CBC):
 - Used for discrete choice modelling
 - Respondent chooses one product, instead of rating them
 - Count the number of wins to calculate impact

Concluding Remarks

- Design of attributes is a crucial step as choices between poorly defined levels can render the exercise meaningless.
- Assigning levels for each attribute is critical in eliciting consumer preferences.



References

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