The Differential Representation of Number and Gender in Spanish

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Outline

• The questions:
  1. Are Number and Gender the same kind of category?
  2. Within Number and Gender, what are the specific feature values?

• The tool:
  Spanish agreement experiment (Number and Gender)

• The answers:
  1. Number ≠ Gender
  2. Number and Gender are structured differently
THE QUESTIONS
Setting the stage

Phi-feature geometry: Phi-features are internally structured in a hierarchical way

(Harley & Ritter 2002, Béjar & Rezac 2009, Preminger 2014, a.o.)
Hierarchy

Feature geometry (Harley & Ritter 2002)

Referring Expression (=Agreement/Pronoun)

PARTICIPANT
- Speaker
- Addressee

INDIVIDUATION
- Minimal
- Group
- Class
  - Augmented
  - Animate
  - Inanimate/Neuter
    - Masc.
    - Fem
Hierarchy

Feature geometry (Harley & Ritter 2002)

Referring Expression (=Agreement/Pronoun)

PARTICIPANT

Speaker  Addressee

INDIVIDUATION

Minimal  Group  Class

Augmented  Animate  Inanimate/Neuter

Masc.  Fem
Hierarchy

Feature geometry (Harley & Ritter 2002)

Referring Expression (=Agreement/Pronoun)

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- Minimal
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- Group
- Class
- Animate
- Inanimate/Neuter
- Masc.
- Fem
Relationship between Number and Gender under agreement

- Gender is bundled with Number
- Gender is projected and valued separately
Gender bundled with Number

No separate GenP; gender morphology can be accounted for as a feature on Num (Ritter 1993; also Carstens 2000, 2003)

– Empirical considerations (ambigenerics; gender on inanimates is uninterpretable)

– Theoretical considerations: Elimination of a projection that lacks consistent semantics (Chomsky 1995)
Gender bundled with Number

No separate GenP; gender morphology can be accounted for as a feature on Num (Ritter 1993; also Carstens 2000, 2003)

– Empirical considerations (ambigenerics; gender on inanimates is uninterpretable)—but see Kramer (2009, 2013) for equally valid empirical considerations against this view

– Theoretical considerations: Elimination of a projection that lacks consistent semantics (Chomsky 1995)—but this is not an issue if one assumes feature valuation rather than interpretability as the determining force in agreement (Pesetsky & Torrego 2007; Preminger 2014)
Gender independent of Number

Gender morphology on a nominal stem heads its own projection, with NumP dominating GenP (Piccallo 1991; Carminati 2005; Antón-Méndez et al. 2002)

If N raises through Gen to Num the order Stem-Gen-Num is predicted, consistent with cross-linguistic facts

e.g., Spanish   \( libr_N-o_{Gen}-s_{Num} \)
Gender independent of Number

Gender morphology on a nominal stem heads its own projection, with NumP dominating GenP

(Picallo 1991; Carminati 2005; Antón-Méndez et al. 2002)

If N raises through Gen to Num the order Stem-Gen-Num is predicted

But, if gender is just a feature on N the same order is predicted
Gender: Independent and distributed

Distributed gender: gender as a feature on \( n \) (natural gender) and on the root (lexical gender); (cf. Kramer 2009; 2013; Duek 2012; Matushansky 2013, and references therein)
Gender: Independent and distributed

- Distributed gender: gender as a feature on $n$ (natural gender) and on the root (lexical gender)

\[
\begin{tikzpicture}
  \node (dp) {DP}
  \child {node (dp) {DP}}
  \child {node (nump) {NumP}}
  \child {node (num) {Num}}
  \child {node (np) {$nP$}}
  \child {node (n) {$n$}}
  \child {node (sqrt) {$\sqrt{}$}}
  \node at (dp -| num) {high gender}
  \node at (dp -| np) {low gender}
\end{tikzpicture}
\]

high gender $\sim$ natural gender, 
Sp. *el marido/lamujer*

low gender $\sim$ lexical gender, 
Sp. *el alimento/lacomida*
Gender: Independent and distributed

Distributed gender: gender as a feature on $n$ (natural gender) and on the root (lexical gender); (cf. Kramer 2009; 2013 and references therein)

Greek ellipsis facts:
PF-deletion of nPs with high gender preserves NumP
(Merchant 2014)
Gender: Independent and distributed

- Distributed gender: gender as a feature on $n$ (natural gender) and on the root (lexical gender)

We will be concerned only with low (lexical) gender
Number and Gender: Two options

bundled

independent
Research questions

**Question 1:** Are Number and Gender projected and valued together or are they independent?

Can these possibilities be assessed experimentally?
Evaluating the two options

• Needed: a language with both Number and Gender agreement

• Spanish has both Number and Gender on DPs entering into agreement
  – Two numbers, singular and plural
  – Two genders, masculine and feminine
Spanish agreement

Determiners, adjectives, and participles agree in number and gender with noun

el cuaderno cerrado   los cuadernos cerrados
la manzana roja       las manzanas rojas
el árbol alto         los árboles altos

Gender and number agreement also maintained in anaphors

Los cuadernos, no los tengo
'the notebooks, I don't have them'
Visibility of feature values

• A value can be
  – specified (present, visible, active, marked), or
  – unspecified (absent, invisible, inert, unmarked)

• We will be using (un)specified, atheoretically
  – specified → +
  – unspecified → absent
Number: Feature content

• PL is morphologically specified (-s vs. -∅)
• SG is semantically specified (atoms vs. everything)
Establishing semantic specification

Taghlib test: “Only the unmarked [unspecified—ZMG] form of a pair of two features can be used to refer to a plurality of individuals, only some of which have the marked [specified—ZMG] property.”

(Greenberg 1966; Sauerland et al. 2005)
Number: semantic specification

Singular reference included with use of the plural
Number: Feature content

You are welcome to bring your children

Every boy should bring his sisters to the party

el certificado médico para la tenencia de animales peligros

→ Singular reference included with use of the plural
Number: Feature content

You are welcome to bring your child

Every boy should bring his sister to the party

el certificado médico para la tenencia del animale peligro

→ Plural reference NOT included with use of the singular
(experimentally supported by Sauerland et al., 2005)
Theories of number: two features, SG and PL, hosted in NumP on the DP spine

$$[[\text{SG}]] = \lambda P: \forall x \in P[\mu(x) = 1]. P$$

$$[[\text{PL}]] = \lambda P. P$$

(Sauerland 2003; Scontras 2013a, b)
Spanish gender: Feature content

- Distribution:
  - masculine 53%,
  - feminine 47%

- Equally specified morphologically
  - Most common word marker associated with feminine: -a
  - Most common word marker associated with masculine: -o
Spanish gender: Feature content

**Taghlib test:**
- *el padre* (M) ‘father’
- *la madre* (F) ‘mother’
- *los padres* (M) ‘parents’, i.e., ‘mother and father’

→ Feminine reference included with use of the masculine

→ *las madres* (F) ‘mothers’, NOT ‘mother and father’

→ Masculine reference NOT included with use of the feminine
Reference to groups: agreement with coordinate structures including M and F nouns is always masculine (virile agreement)

*el libro*$_{\text{M}}$ y *la pintura*$_{\text{F}}$ son *preciosos*$_{\text{M.PL}}$/*presiosas*$_{\text{F.PL}}$

‘the book and the painting are expensive’
Spanish gender: Feature content

• Harris (1991): Spanish gender is *single-valued*: feminine vs. unspecified (absence of feminine)
  “Unmarked gender: literally the absence of any information about gender in lexical entries”

• Main arguments:
  – When in doubt use masculine (incl. neologisms)
  – Group of people with mixed gender → masculine agreement
Spanish gender: Feature content

• Alternative: Spanish gender is *multi-valued*, but feminine is more visible or marked (Roca 1989; Domínguez et al. 1999; Alarcón 2006)
Summary of Spanish features

Number:
- PL is morphologically specified
- SG is semantically specified
Theory of number posits two active features

Gender:
- M and F equally specified morphologically
- F may be semantically specified (Harris 1991); is M unspecified?
One or two active features?
Research questions

**Question 1:** Are Number and Gender projected and valued together or are they independent? Can this valuation be assessed experimentally?

**Question 2:** What is the content (value composition) of the Number and Gender features in Spanish? Can we assess their content experimentally?
THE TOOL: SPANISH NUMBER/GENDER AGREEMENT EXPERIMENT
Assumptions

• Relationship between grammar and parser: grammar is the parser (Phillips 2010, 2013)

• Grammar and language processing are part of the same system, at different levels of abstraction

• By investigating processing, we are able to access mental representations
Desiderata

• Create a potential conflict in phi-features (number vs gender) – i.e., agreement error

• Keep the goal and probe at a distance (in contrast to many existing studies where they are adjacent)
Desiderata and Spanish

• What we need:
  – Create a potential conflict in phi-features (number vs gender)
  – Keep the goal and probe at a distance

• What Spanish has to offer:
  Small clauses with agreeing adjectival predicate:

  ... considerar DP extremamente Adj ...

  (SUBJ) VERB [DP DP1 [PP P DP2]] ADVERB ADJ...

(Contreras 1987; 1995; Jiménez-Fernández & Spyropoulos 2013)
Small clause structure

Los estudiantes dejaron el cuaderno en el escritorio cuidosamente cerrado
“The students left the notebook on the desk carefully closed.”

(Spanish: Contreras 1987; 1995; Jiménez-Fernández & Spyropoulos 2013; beyond Spanish: Cardinaletti & Guasti 1995; Basilico 2003; Progovac 2006; Citko 2011, a.o.)
Feature valuation

Los estudiantes dejaron el cuaderno en el escritorio cuidosamente cerrado.

bundled Num and Gen

Independent Num and Gen
Experimental design

• Auditory stimuli (N=16)
• Recorded by a male native speaker of Spanish
• Participants: 60 native speakers of Spanish
• Measures
  – Acceptability rating (1-5, 1: impossible, 5: completely possible)
  – Response time
Experimental design

Los estudiantes dejaron el cuaderno en el escritorio cuidadosamente cerrado.

“The students left the notebook on the desk carefully closed”
Number design
(gender held constant)

(SUBJ) VERB NP1 PREP NP2 ADVERB ADJ...

Three factors:

NP1 number (SG vs. PL)
NP2 number (SG vs. PL) 8 conditions
ADJ number (SG vs. PL)
Los estudiantes dejaron el cuaderno en el escritorio cuidadosamente cerrado.

Los estudiantes dejaron los cuadernos en los escritorios cuidadosamente cerrados.

Example NP1-M NP2-M item
**Number design**

**Example NP1-M NP2-M item**

<table>
<thead>
<tr>
<th>NP1</th>
<th>NP2</th>
<th>ADJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td>SG</td>
<td>SG</td>
</tr>
<tr>
<td>SG</td>
<td>PL</td>
<td>SG</td>
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<tr>
<td>PL</td>
<td>SG</td>
<td>PL</td>
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<tr>
<td>PL</td>
<td>PL</td>
<td>PL</td>
</tr>
</tbody>
</table>
Number design

Example NP1-M NP2-M item

<table>
<thead>
<tr>
<th>NP1</th>
<th>NP2</th>
<th>ADJ</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG</td>
<td>SG</td>
<td>SG</td>
<td>Los estudiantes dejaron el cuaderno en el escritorio cuidadosamente cerrado</td>
</tr>
<tr>
<td>SG</td>
<td>SG</td>
<td>PL</td>
<td>Los estudiantes dejaron el cuaderno en el escritorio cuidadosamente cerrados</td>
</tr>
<tr>
<td>SG</td>
<td>PL</td>
<td>SG</td>
<td>Los estudiantes dejaron el cuaderno en los escritorios cuidadosamente cerrado</td>
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<tr>
<td>PL</td>
<td>SG</td>
<td>PL</td>
<td>Los estudiantes dejaron los cuadernos en el escritorio cuidadosamente cerrados</td>
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<tr>
<td>PL</td>
<td>PL</td>
<td>SG</td>
<td>Los estudiantes dejaron los cuadernos en los escritorios cuidadosamente cerrado</td>
</tr>
<tr>
<td>PL</td>
<td>PL</td>
<td>PL</td>
<td>Los estudiantes dejaron los cuadernos en los escritorios cuidadosamente cerrados</td>
</tr>
</tbody>
</table>
Los estudiantes dejaron el cuaderno en el escritorio cuidadosamente cerrado

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Los estudiantes dejaron los cuadernos en los escritorios cuidadosamente cerrados
Number Design

<table>
<thead>
<tr>
<th>Ungrammatical</th>
<th>Grammatical</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPP</td>
<td>SPS</td>
</tr>
<tr>
<td>PSS</td>
<td>PSS</td>
</tr>
<tr>
<td>SSS</td>
<td>SSS</td>
</tr>
<tr>
<td>PPS</td>
<td>PPP</td>
</tr>
</tbody>
</table>
Gender design
(number held constant)

(SUBJ) VERB NP1 PREP NP2 ADVERB ADJ...

Three factors:

NP1 gender (M vs. F)
NP2 gender (M vs. F)
ADJ gender (M vs. F)  

8 conditions
## Gender design

### Example NP1-SG NP2-SG item

<table>
<thead>
<tr>
<th>NP1</th>
<th>NP2</th>
<th>ADJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
</tbody>
</table>

| F   | F   | F   | Los estudiantes dejaron la *libreta* en la *estantería* cuidadosamente *cerrada* |
Gender design

Example NP1-SG NP2-SG item

<table>
<thead>
<tr>
<th>NP1</th>
<th>NP2</th>
<th>ADJ</th>
<th>Spanish Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
<td>Los estudiantes dejaron el cuaderno en el escritorio cuidadosamente cerrado</td>
</tr>
<tr>
<td>M</td>
<td>F</td>
<td>M</td>
<td>Los estudiantes dejaron el cuaderno en la estantería cuidadosamente cerrado</td>
</tr>
<tr>
<td>F</td>
<td>M</td>
<td>F</td>
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</tr>
<tr>
<td>F</td>
<td>F</td>
<td>F</td>
<td>Los estudiantes dejaron la libreta en la estantería cuidadosamente cerrada</td>
</tr>
</tbody>
</table>
Gender design

Example NP1-SG NP2-SG item

<table>
<thead>
<tr>
<th>NP1</th>
<th>NP2</th>
<th>ADJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>M</td>
<td>M</td>
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<tr>
<td>M</td>
<td>M</td>
<td>F</td>
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<td>F</td>
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<td>F</td>
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</tbody>
</table>
## Gender Design

<table>
<thead>
<tr>
<th>Ungrammatical</th>
<th>Grammatical</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFF</td>
<td>MFM</td>
</tr>
<tr>
<td>FMM</td>
<td>FFM</td>
</tr>
<tr>
<td></td>
<td>MMM</td>
</tr>
<tr>
<td></td>
<td>FFF</td>
</tr>
</tbody>
</table>
Research questions

Question 1: Are Number and Gender bundled or are they independent?
Question 1: Predictions

Bundled Num and Gen

• Ungrammaticality on number and ungrammaticality on gender should be rated the same
Question 1: Predictions

Bundled Num and Gen
• Ungrammaticality on number and ungrammaticality on gender should be rated the same

Independent Num and Gen
• Ungrammaticality on number and ungrammaticality on gender do not have to be rated the same
Average overall ratings: Beyond the absolute numbers

3.69

4.19

P < 0.001
Results: Number

grammaticality effect for SG and PL
Results: Gender

M head noun: grammaticality effect

F head noun: no grammaticality effect

P < 0.01

N.S.
Question 1: Predictions

Bundled Num and Gen
• Ungrammaticality on number and ungrammaticality on gender should be rated the same ✗

Independent Num and Gen
• Ungrammaticality on number and ungrammaticality on gender do not have to be rated the same ✔
Question 1: Predictions

Bundled Num and Gen

• Ungrammaticality on number and ungrammaticality on gender should be rated the same

• Agreement attraction effects in one category should lead to agreement attraction effects in the other category

Independent Num and Gen

• Ungrammaticality on number and ungrammaticality on gender do not have to be rated the same

• Agreement attraction effects in Num should be independent of agreement attraction effects in Gen
Agreement attraction

the key to the cabinets were lost

Grammatical feature of local noun displaces grammatical feature of head noun

(Bock & Eberhard 1993; Franck et al. 2006; den Dikken 2001; Wagers et al. 2009, a.o.)
Agreement attraction

the key to the cabinets were lost

>>

the keys to the cabinet was lost

Hence PL as the driving force for attraction
(see Phillips 2013 and references therein)

Attraction is driven by morphological visibility
Results: Number

agreement attraction from PL

P < 0.05
Agreement attraction

• If Number and Gender are bundled, Number attraction should result in Gender attraction

• It does NOT:

F-SG  M-PL  M-PL  3.3 (RT 2007 ms)

F-SG  F-PL  F-PL  4.3 (RT 1905 ms)
Results: Gender

No attraction from the feminine
Results: Gender

No attraction from the masculine
Question 1: Predictions

- Bundled Num and Gen
  - Agreement attraction effects in one category should lead to agreement attraction effects in the other category

- Independent Num and Gen
  - Agreement attraction effects in Num should be independent of agreement attraction effects in Gen
Question 1: Predictions

<table>
<thead>
<tr>
<th>Bundled Num and Gen</th>
<th>Independent Num and Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Ungrammaticality on number and ungrammaticality on gender are not rated the same</td>
</tr>
<tr>
<td></td>
<td>• Agreement attraction effects in Num are independent of agreement attraction effects in Gen</td>
</tr>
</tbody>
</table>
Research questions

Question 2 (rephrased): Are Number and Gender multi-valued or single-valued categories?
Question 2: Predictions

Both Num and Gen are multi-valued

- Grammaticality effects should be the same across Num and Gen

Num is multi-valued, Gen is single-valued

- Grammaticality effects should be observed for both values in Num and only for the specified value in Gen
Results: Number

grammaticality effect for SG and PL

P < 0.05
Results: Gender

M head noun: grammaticality effect

F head noun: no grammaticality effect

P < 0.01

N.S.
Results: Gender

M head noun: grammaticality effect

F head noun: no grammaticality effect
Results: Agreeing adjective

- only feminine adjectives yield grammaticality effects
- masculine adjectives can agree with feminine head nouns
  - such agreement is rated as high as grammatical sentences
Results: Agreeing adjective

The ungrammatical:

Los estudiantes dejaron la carta en la mesa cuidadosamente cerrado (rated 4.1)

rated equally high as the grammatical:

Los estudiantes dejaron la carta en la mesa cuidadosamente cerrada (rated 4.2)
Question 2: Predictions

Both Num and Gen are multi-valued

• Grammaticality effects should be the same across Num and Gen

Num is multi-valued, Gen is single-valued

• Grammaticality effects should be observed for both values in Num and only for the specified value in Gen
Question 2: Predictions

Both Num and Gen are multi-valued

- Grammaticality effects should be the same across Num and Gen
- Ungrammatical detection should take the same time across Num and Gen

Num is multi-valued, Gen is single-valued

- Grammaticality effects should be observed for both values in Num and only for the specified value in Gen
- Ungrammaticality detection should take longer in Num than in Gen
Predictions

• If Number is multi-valued and Gender is single-valued,

• Number valuation should take longer:
Predictions

• Gender errors should be resolved faster than number errors

• If both probe and goal have specified feature (as in Number), matching should take longer than if only one of them is specified (as in Gender)
Predictions

• Gender errors should be resolved faster than number errors

• If both probe and goal have specified feature (as in Number), matching should take longer than if only one of them is specified (as in Gender)

<table>
<thead>
<tr>
<th>Probe and Goal match?</th>
<th>Value?</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>specified</td>
</tr>
<tr>
<td>YES</td>
<td>unspecified</td>
</tr>
<tr>
<td>NO</td>
<td>specified</td>
</tr>
<tr>
<td>NO</td>
<td>unspecified</td>
</tr>
</tbody>
</table>

number error

gender error
Testing the prediction

• How quickly do Spanish speakers spot ungrammaticality?
Results: Ungrammaticality detection

reaction times (ms) for number vs. gender errors

<table>
<thead>
<tr>
<th></th>
<th>NUMBER ERRORS</th>
<th>GENDER ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P = 0.19
Results: Ungrammaticality detection

• Gender errors are resolved faster than number errors
• If both probe and goal have specified feature (as in Number), matching takes longer than if only one of them is specified (as in Gender)
Question 2: Predictions

Both Num and Gen are multi-valued

• Ungrammaticality detection should take the same time across Num and Gen

Num is multi-valued, Gen is single-valued

• Ungrammaticality detection should take longer in Num than in Gen
Question 2: Predictions

Both Num and Gen are multi-valued ✗

Num is multi-valued, Gen is single-valued ✔

• Grammaticality effects should be observed for both values in Num and only for the specified value in Gen

• Ungrammaticality detection should take longer in Num than in Gen
THE ANSWERS
Discussion

• **Question 1:** Are the phi-features Num and Gen valued together or separately?
Discussion

**Question 1:** Are the phi-features Num and Gen valued together or separately?

**Answer:** Separately

Num ≠ Gen
Discussion

Additional evidence for severing Num and Gen: eventive nominals have gender but do not pluralize and have no NumP

*la construcción de los puentes
*las construcciones de los puentes
‘the construction(*s) of the bridges’
(cf. Alexiadou et al. 2010)
Discussion

• **Question 2**: What is the content of Number and Gender features, respectively?
Discussion

• **Question 2:** What is the content of Number and Gender features, respectively?

• For Number, both **SG** and **PL** show grammaticality effects.

• This matches current thinking on the feature content of Number: both **SG** and **PL** are specified.
Discussion

• **Question 2**: What is the content of Number and Gender features, respectively?

• For Spanish Gender, only *feminine* adjectives yield grammaticality effects.

• This matches Harris (1991) on the feature content of Gender: only *feminine* is specified.
In conclusion

**Question 1:** Are Number and Gender projected and valued together or are they independent?

*They are independent; valuation in Spanish is done separately*

Can this valuation be assessed experimentally?

*Yes (see also Antón-Méndez et al. 2002, for production data that speak to the same result)*
In conclusion

- **Question 2:** What is the content (value composition) of each feature?

  *In Spanish, Number is *multi*-valued and Gender is *single*-valued*
In conclusion

**Question 2:** What is the content (value composition) of each feature?

_In Spanish, Number is multi-valued and Gender is single-valued_

Can we assess their content experimentally?

Yes, and similar methodology could be applied to:

- other languages
- other categories whose status is under debate
THANK YOU!

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