

# Chinese 'dou' and Cumulative Quantification

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## Introduction

### 1. Previous Analysis:

Dou is a **distributivity** operator (Lin 1998, and references therein).

#### (1) Only cumulative reading

san-ge haizi chi-le shi-ge pingguo  
three-CL kid eat-ASP ten-CL apple  
'three kids between them ate ten apples.'

#### (2) Only distributive reading

san-ge haizi **dou** chi-le shi-ge pingguo  
three-CL kid DOU eat-ASP ten-CL apple  
'three kids each ate ten apples.'

#### (1\*) $\exists X [3\text{-kids}(X) \wedge \exists Y [10\text{-apples}(Y) \wedge \langle X, Y \rangle \in \text{ate}]]$

#### (2\*) $\exists X [3\text{-kids}(X) \wedge X \in \text{ate} \wedge \exists Y [10\text{-apples}(Y) \wedge \text{ate}(X, Y)]]$

$X \in \text{ate}$  iff  $X$  is the sum of one or more elements of  $P$  (Link, 1987), and  $\langle X, Y \rangle \in \text{ate}$  iff  $\langle X, Y \rangle$  is the sum of one or more pairs in  $R$  (Sternfeld, 1998).

**Problem:** *dou* is compatible with cumulative readings involving numerical quantifiers, which is unexpected if *dou* is uniformly translated as a 1-place dist operator \* (Link 1983).

## Background: A Neo-Davidsonian Framework

We adopt a Neo-Davidsonian framework, whereby verbs, VPs, and IPs denote **predicates over events**.

### (1\*) The cumulative reading of (1)

$\exists E [\text{ate}(E) \wedge \exists X [\text{three-kids}(X) \wedge \text{agent}(E) = X]]$   
 $\wedge \exists Y [\text{ten-apples}(Y) \wedge \text{theme}(E) = Y]]$

"There exist a set  $X$  of three kids, a set  $Y$  of ten apples, and a set  $E$  of eating events, each member of  $X$  is an agent of a member of  $E$ , each member of  $E$  has a member of  $X$  as its agent, each member of  $Y$  is a theme of a member of  $E$ , each member of  $E$  has a member of  $Y$  as its theme".

Two cumulative relations in (1\*), not just one:

- between the **sum event** and the **sum agent**,
  - between the **sum event** and the **sum theme**.
- They are introduced by the thematic roles agent and patient.

## Proposal: DOU is a Theta Role Modifier

Claim: *dou* is a theta role modifier.

(3)  $[[\text{dou}]] = \lambda R \langle v, e \rangle. \lambda P \langle e \rangle. \lambda V \langle v \rangle. \lambda E.$

$\exists X. P(X) \wedge \langle E, X \rangle \in \text{ate} \wedge \lambda x. [\text{ATOM}(x) \wedge \theta(e) = x \wedge V(e)]$

In (3),  $e$  ranges over events and sums of events;  $x$  ranges over individuals, and  $X$  over individuals and sums of individuals. *Dou* combines with a theta role  $R$ , a noun phrase  $P$ , and a verbal projection  $V$ . The resulting predicate states that every atomic part of  $X$  is the theta role of some part of  $E$ , with none of  $E$  left out; and that the verb phrase  $V$  applies to each such part of  $E$ .

## The idea in a nutshell

- dou* contains a \*\* operator over two-place predicates with an argument and an event position; the verb phrase is distributed over the parts of the event argument, and the event argument remains accessible for modifiers higher up the tree such as agent and existential closure.
- A theta role modified by *dou* causes its bearer to **take distributive scope over the event predicate it c-commands**.
- If that predicate contains a quantifier, *dou* distributes over it. Otherwise, the effect of *dou* is almost vacuous.

## DOU with Distributive and Cumulative Readings

The distributive reading of (2) with *dou* under this analysis is (2').

(2')  $\exists E \exists X [\text{three-kids}(X) \wedge \langle \langle E, X \rangle \in \text{ate} \wedge \lambda e'. \lambda x. [\text{atom}(x) \wedge \text{agent}(e') = x] \wedge \text{eat}(e') \wedge \exists X [\text{ten-apples}(X) \wedge \text{theme}(e') = X]]]]$

DOU in *ba*-constructions is compatible with both distributive and cumulative readings.

A *ba*-construction has the surface word order of "DP1+ba+DP2+VP". *ba* is claimed to be a spell-out of little *v* that introduces the agent DP1 (Zhao 2009); DP2 is the theme or patient.

#### (4) DP1+ba+DP2+VP

Only cumulative reading

san-ge haizi ba shi-ge pingguo chi-le  
three-CL kid BA ten-CL apple eat-ASP  
'Three kids between them ate 10 apples.'

#### (5) DP1+ba+DP2+dou+VP

Only cumulative reading

san-ge haizi ba shi-ge pingguo **dou** chi-le  
three-CL kid BA ten-CL apple DOU eat-ASP  
'Three kids each ate 10 apples.'

#### (6) DP1+dou+ba+DP2+VP

Only distributive reading

san-ge haizi **dou** ba shi-ge pingguo chi-le  
three-CL kid DOU BA ten-CL apple eat-ASP  
'Three kids each ate ten apples.'

(4\*)  $\exists E [\text{ate}(E) \wedge \exists X [\text{ten-apples}(X) \wedge \text{theme}(E) = X]] \wedge \exists Y [\text{three-kids}(Y) \wedge \text{agent}(E) = Y]]$

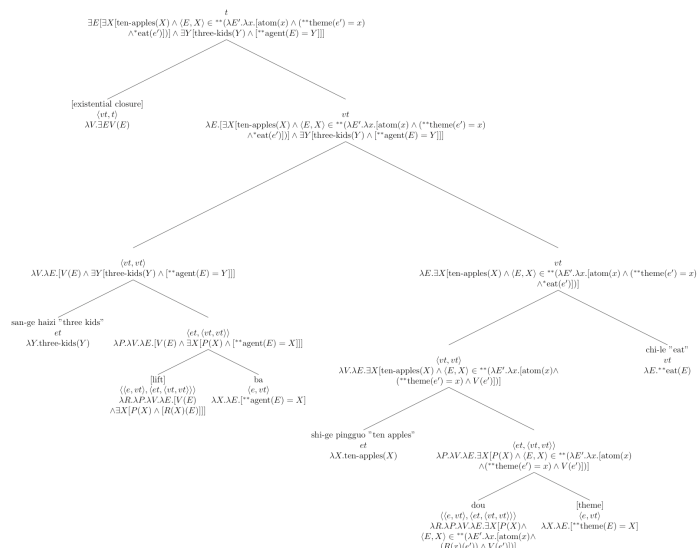
(5\*)  $\exists E [\exists Y [\text{three-kids}(Y) \wedge \text{agent}(E) = Y]] \wedge \exists X [\text{ten-apples}(X) \wedge \langle E, X \rangle \in \text{ate} \wedge \lambda e'. \lambda x. [\text{atom}(x) \wedge \text{theme}(e') = x] \wedge \text{eat}(e')]]]$

(6\*)  $\exists E \exists X [\text{three-kids}(X) \wedge \langle E, X \rangle \in \text{ate} \wedge \lambda e'. \lambda x. [\text{atom}(x) \wedge \text{agent}(e') = x] \wedge \text{eat}(e') \wedge \exists Y [\text{ten-apples}(Y) \wedge \text{theme}(e') = Y]]]]$

In (6), *ba* places the event into a relation with the agent, and *dou* determines that this is done to each member of the agent. If *dou* was absent in (6), *ba* would place the event into a relation with the entire set of three kids, giving the cumulative reading (4).

In (5) we assume that *dou* scopes **only over the verb** as indicated by its overt position, since Chinese scope seems to follow the surface order (Huang 1982). As a result, the contribution of *dou* is minimal: the only thing it contributes is that each apple was the theme of an eating event, which is vacuous since eating is distributive on its theme.

A derivation for (5):



## A puzzle: Dou in BEI-constructions

In a *bei*-construction "DP1 *bei* DP2 VP", DP1 is usually the theme/patient; and DP2 is the agent. *Dou* is also compatible with cumulative readings in *bei*-constructions, but the position of *dou* relative to [*bei* DP2] does not affect the cumulative readings.

#### (7) DP1+ *bei*+DP2+VP

Cumulative reading only

shi-ge pingguo *bei* san-ge haizi chi-le  
ten-CL apple *bei* three-CL kid eat-ASP  
'Ten apples were eaten by three kids together.'

#### (8) DP1+ *bei*+DP2+dou+VP

Cumulative reading only

shi-ge pingguo *bei* san-ge haizi **dou** chi-le  
ten-CL apple *bei* three-CL kid dou eat-ASP

#### (9) DP1+ dou+*bei*+DP2+VP

Cumulative reading only

shi-ge pingguo **dou** *bei* san-ge haizi chi-le  
ten-CL apple dou *bei* three-CL kid eat-ASP

Problem: Dou in (9) does not give a distributive reading as (6).

**Hypothesis 1:** The semantics of *bei* is similar to the semantics of *ba*, both are translated as agent. And [*bei*-quantifier] as an appositive, which does not take scope under another quantifier.

**Hypothesis 2:** The semantics of *bei* differs from the semantics of *ba*. While *ba* introduces an agent, *bei* does not. *Bei* has been proposed as a verbal category (Feng 1980).

## References

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