The nature of transparency effects in Chinese compound processing

James Myers
National Chung Cheng University
Gary Libben
Bruce Derwing
University of Alberta
Abstract

• Two new variants on the lexical decision task:
  – **Blocking** by transparency to see if strategies from one block can carry over to the other.
  – **Internal priming**, i.e., highlighting different components at different times, to see which components are used when in which type of compound.

• **Conclusion**: Decomposition is strategic rather than obligatory; it appears to be generally avoided for opaque words, and even for transparent words it may have to be explicitly “turned on”.
Decomposition questions

• Is morphological decomposition obligatory?
• Does it occur prelexically or postlexically?
• If decomposition only occurs when it’s useful, does it occur for existing words, which can always be looked up whole?
Transparency as a tool

- Opaque compounds would not benefit from decomposition, since the components compete with the whole word.
- Transparent compounds may benefit from decomposition, assuming that related words are linked in the mental lexicon.
- Manipulating transparency can thus serve as a tool to address decomposition questions.
Transparency effects in Chinese

- **Transparency speeds up** response times (RTs) in lexical decision for compounds (e.g., Su, 1998)
- **Negative morpheme frequency effects** in word lexical decision for opaque compounds (e.g., Peng, et al., 1999)
- Consistent with obligatory decomposition: activated components of opaque compounds compete with whole-word meaning
Opacities in Chinese studies

• The above effects are not fully robust (failures to replicate include Lü, 1996)
• Opaque compounds sharing components prime each other only with a sufficient time lag (Liu & Peng, 1997)
• Such results suggest that decomposition could be non-obligatory and/or postlexical
A Chinese twist

• The orthographic unit is the morpheme-like character, with no spaces between words

• This suggests that the relevant process for Chinese compounds may be composition rather than decomposition

• The symptoms of composition would be the same as for obligatory prelexical decomposition
Our goals

- Examine the possibility that decomposition is an opportunistic strategy
- Explore the time course of (de)composition
- To these ends, we developed two new variants on the lexical decision task
Blocking by transparency

• What if we gave a block of fully transparent compounds (TT) prior to a block of fully opaque compounds (OO), or the reverse?

• Would strategies develop in the first block and then carry over to the second block?
  – A (de)composition strategy would benefit TT
  – A whole-word strategy would benefit OO
Where the materials came from

• All were nominal compounds of mid-range frequency composed of free morphemes
• 140 naive speakers judged compounds for semantic relatedness with their components
• Compounds classified into OO, OT, TO, TT by selecting items for each set furthest from the median of the mean scores (following Libben, et al., 2003)
Experiment overview

- 120 trials (60 real compounds: 30 each of TT, OO, matched for frequency)
- 40 participants
  - **TT-OO group** (20 participants): TT block before OO block
  - **OO-TT group** (20 participants): OO block before TT block
- Visual lexical decision (foils composed of real characters)
Analysis

• Lognormed RTs for correct word responses were submitted to a linear mixed effect model with categorical factors **Block Order** (TT-OO vs. OO-TT) and **Compound Type** (TT vs. OO), plus covariate **Trial Position** (1-120)

• No main effect of Compound Type, but there was a three-way interaction \( p < 0.01 \): RTs in TT block of OO-TT dropped faster
TT-OO block order

\[ R^2 = 0.0007, \quad p > 0.5 \]
\[ R^2 = 0.004, \quad p > 0.1 \]
OO-TT block order

![Graph showing RT (ms) versus Trial Position for OO and TT block orders. The graph includes two distinct regression lines. The OO block regression line has an $R^2 = 0.001$, $p > 0.3$. The TT block regression line has an $R^2 = 0.02$, $p < 0.01$. The data points are represented as red diamonds, with the OO block data on the left side of the graph and the TT block data on the right side.](image-url)
Interpretation

• **Decomposition is not obligatory**
  – Context makes a difference
  – Decomposition only applied to TT when contrasted with OO (in OO-TT block order)

• **Decomposition is not generally useful**
  – It doesn’t help transparent compounds so much as hurt opaque ones

• **Composition thus cannot be the sole strategy either**
Time course questions

• When decomposition occurs, how does it make transparent compounds faster?
• Is it because prelexical activation of components is an efficient strategy for accessing transparent compounds?
• Or is it because postlexical activation of components doesn’t conflict with the confirmation of transparent compounds?
Target-internal priming

• What if we highlight components while readers judge compounds? This might affect different stages differently.
  – Position of transparency: OO, OT, TO, TT
  – Position of highlight: Character 1, Character 2
  – Timing of highlighting: Early, Late

• Highlighting components should affect RT only at times the system is using them
Experiment overview

• 144 targets (72 real compounds: 18 each of OO, OT, TO, TT, matched for frequency)
• 42 participants in a Latin square
• Black characters “flashed” red (50 ms)
  – Character 1, Character 2, Both (as control)
  – Early (SOA = 0 ms), Late (SOA = 200 ms)
• Visual lexical decision (foils composed of real characters)
Examples

- Char1 Early: 国王 → 国王 → 国王
- Char2 Early: 国王 → 国王 → 国王
- Both Early: 国王 → 国王 → 国王
- Char1 Late: 国王 → 国王 → 国王
- Char2 Late: 国王 → 国王 → 国王
- Both Late: 国王 → 国王 → 国王

(TT guo2wang2 “king”)
Analysis

• Lognormed RTs for correct word responses were submitted to linear mixed effect model with factors **Compound Type** (OO, OT, TO, TT), **Position** (Char1, Char2, Both), and **Flash Time** (Early, Late)

• No main effects, but there was a three-way interaction ($p < 0.02$)
Effects of early flashing

(Bars represent standard errors from a 3-way ANOVA on raw RTs)
Effects of late flashing

(Bars represent standard errors from a 3-way ANOVA on raw RTs)
Result highlights

• Early flashing:
  – Flashing char1 slowed RT if this component was opaque (OO, OT)
  – Flashing char1 sped RT (TT only)

• Late flashing:
  – Flashing char2 sped RT if char1 was transparent (TO, TT)
  – No other obvious patterns
Interpretation

• **Left-to-right processing**
  – Char1 effects early, char2 effects late
  – Char1 transparency more relevant than char2

• **Decomposition isn’t generally useful**
  – OO & OT slowed by early char1 flashing
  – TO unaffected by early char1 flashing

• **Postlexical effects?**
  – Role of char1 transparency in char2 flashing effects
Overall summary

• **Blocking:** When transparent block followed opaque block, transparent compound RTs sped up only gradually.

• **Internal priming:** Flashing first component early slowed RT for opaque-initial compounds, but RT for transparent-initial compounds were sped only by late second component flashing.
Conclusions

• Decomposition occurs:
  – Speed-up in TT after OO block may imply that decomposition was “turned on”
  – Left-to-right effect in flashing experiment is consistent with prelexical decomposition

• But it isn’t obligatory:
  – TT wasn’t faster than OO in general
  – Opaque access derailed only if a component was highlighted, and only if it was the initial one
Acknowledgements

• Research assistants: Wang Wenling, Chiu Chenhao, Peng Yuru

• Financial support: Chiang Ching-Kuo Foundation (RG001-D-02) and a SSHRC MCRI grant

• Contact: Lngmyers@ccu.edu.tw
References


