Keeping an eye on idioms: Investigating non-compositional processing with eye-tracking

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Compositionality

• The meaning of an expression can be constructed from:
  • The meaning of its constituents
  • The way in which those constituents are composed
Idioms

- In many cases violate or skirt the edges of compositionality
- Are pervasive (Jackendoff, 1995)
- Are frequent (Pawley & Syder, 1983)
Word-Like Behavior

• **Literalness Priming** (Bobrow & Bell, 1973)

• **Non-Literal expressions are processed faster than literal ones** (Swinney & Cutler, 1979; Gibbs & Gonzales, 1985; Cacciari et al. 2007; Holsinger & Kaiser, 2010)
Idiom List
- kick the bucket
- eat your words
- hold your horses

Input

Lexicon
Lexical Representation Models

Input

Lexicon

- kick
- kick the bucket
- bucket
Structural Behavior

• Grammatical Sensitivities
  • * John kick the bucket yesterday.

• Syntactic and Lexical Flexibility
  • We’ll walk that path when we get to it.

• Occupy a continuum of opacity
  • Look up - Throw out - Chew out

• Exhibit structural priming effects (Konopka & Bock, 2009; Peterson et al, 2001)
Hybrid Models

(Cutting & Bock, 1997; Sprenger et al., 2006)
Lexicon

kick

kick the bucket

bucket

pail
Questions

• Is consideration of idiomatic meaning modulated by the string’s syntactic context?

• Do semantically related, but non-idiomatic strings (e.g. *kick the pail*) induce consideration of idiomatic meaning?

• What is the time course of idiom activation in semantically unbiased contexts?
Experimental Design

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Experiment

We used highly familiar English idioms in a text-based visual world eye-tracking experiment to examine how syntactic and lexical effects modulate consideration of idiomatic meaning.
Experiment

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The Idioms

• 12 Familiar English Idioms
  • Form - verb [a/the/his/her] noun (e.g. kick the bucket, find her feet)
  • Off-line norming study provided metric of familiarity
  • From a larger pool, selected the 12 most familiar that fit the experimental criteria
Experiment

We used highly familiar English idioms in a text-based visual world eye-tracking experiment to examine how syntactic and lexical effects modulate consideration of idiomatic meaning.
Visual World Paradigm

- Participants listen to sentences while looking at objects on the screen

- In this case the ‘objects’ were words (c.f. Meyer, 2005; McQueen & Viebahn, 2007; Heuttig & McQueen, 2007)

- Participants’ point of gaze is tracked while they listen to the sentence
John kicked the bucket last Thursday.
Experiment

We used highly familiar English idioms in a text-based visual world eye-tracking experiment to examine how syntactic and lexical effects modulate consideration of idiomatic meaning.
Syntactic Availability

Is consideration of idiomatic meaning modulated by the word’s syntactic context?

• *Within Sentence Condition*
  
  • *kicked the bucket...*

• *Between Sentence Condition*
  
  • *kicked. The bucket...*
Lexical Availability

Do semantically related, but non-idiomatic strings induce consideration of idiomatic meaning?

• **Idiom Available Condition**
  • ...kick the bucket...

• **Idiom Unavailable Condition**
  • ...kick the pail...
Within Sentence

John **kicked the bucket** last Thursday.
John **kicked the pail** last Thursday.

Between Sentence

It was surprising to see someone as skilled as John completely miss when he **kicked**. **The bucket** full of orange slices was destroyed when he accidentally missed the ball.

It was surprising to see someone as skilled as John completely miss when he **kicked**. **The pail** full of orange slices was destroyed when he accidentally missed the ball.
Experimental Task

• Participants previewed the four words on the screen for 5 seconds and then passively listened to the audio sentence.

• There was no explicit task. Participants were instructed to listen carefully to the audio and maintain attention on the screen (and try to stay awake)

n = 12, 24 targets, 60 fillers
Predictions
Predictions

- Our design allows us to make predictions about the effects of our manipulations as well as when effects will occur.

- We focus on the onset of the noun here

- Noun Onset - *kick the bucket*...
Predictions: Syntax

...kick. The bucket/pail... vs ...kick the bucket/pail...

- Idioms are represented as phrasal representations. Incompatible syntactic context should rule out the idiomatic possibility.

- At the noun, participants will not consider the idiomatic interpretation in the between-sentence conditions.
Predictions: Lexical

...the bucket... vs ...the pail...

• Semantic similarity is predicted to indirectly trigger idiomatic consideration.
• At the noun the parser will consider the idiomatic interpretation in the within-sentence conditions.
• The tendency to consider the idiomatic interpretation will be stronger when the idiom is lexically available (e.g. the bucket will be stronger than the pail)
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Example Graph

- Looks to ‘Toe’
- Looks to ‘Death’
- Looks to Distractors

Proportion of Looks

- Literal Advantage
- Idiom Advantage
- Competition

Time in ms
Between Sentences
Idiom Available Condition

kick. The bucket - Aligned to Noun

Literal Advantage

Looks to ‘Toe’
Looks to ‘Death’
Looks to Distractors
Idiom Unavailable Condition
kick. The pail - Aligned to Noun

- Looks to ‘Toe’
- Looks to ‘Death’
- Looks to Distractors

Literal Advantage
More looks to ‘toe’ than to ‘death’ regardless of the noun that people heard.

Participants do not consider the idiomatic meaning when the string spans a sentential boundary.
Within Sentence
Results at the Noun
Lexical Effects

Persistent, long-lasting competition between the literal and idiomatic interpretations.

Some competition between literal and idiomatic interpretations.

Late advantage for the literal (correct) interpretation.

Early advantage for the idiomatic (incorrect) interpretation.
Predictions: Syntax

...kick. The bucket/pail... vs ...kick the bucket/pail...

- Idioms are represented as phrasal representations. Incompatible syntactic context should rule out the idiomatic possibility.

- At the noun, participants will not consider the idiomatic interpretation in the between-sentence conditions.
Predictions: Syntax

...kick. The bucket/pail... vs ...kick the bucket/pail...

- Idioms are represented as phrasal representations. Incompatible syntactic context should rule out the idiomatic possibility.

  At the noun, participants will not consider the idiomatic interpretation in the between-sentence conditions.

  In fact, participants strongly prefer the literal interpretation.
Predictions: Lexical

...the bucket... vs ...the pail...

• Semantic similarity is predicted to indirectly trigger idiomatic consideration.

• At the noun the parser will consider the idiomatic interpretation in the within-sentence conditions.

• The tendency to consider the idiomatic interpretation will be stronger when the idiom is lexically available (e.g. *the bucket* will be stronger than *the pail*)
Predictions: Lexical

...the bucket... vs ...the pail...

- Semantic similarity is predicted to indirectly trigger idiomatic consideration.
  - Participants consider the idiomatic interpretation even when the idiom is lexically unavailable (i.e. *kick the pail*)
- The tendency to consider the idiomatic interpretation will be stronger when the idiom is lexically available (e.g. *the bucket* will be stronger than *the pail*)
Predictions: Lexical

...the bucket... vs ...the pail...

- Semantic similarity is predicted to indirectly trigger idiomatic consideration.
  - Participants consider the idiomatic interpretation even when the idiom is lexically unavailable (i.e. *kick the pail*)
  - Idiomatic consideration is at least as strong, if not stronger for *kick the pail* than for *kick the bucket*.
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Implications: Syntax

• Syntactic structure, at least large global properties such as the presence of a sentential boundary, is used on-line when interpreting a potentially ambiguous idiom string.

• The parser is not fooled into considering the impossible idiomatic interpretation, and this effect is starts very early.

• This may represent a sort of a shortcut bypassing typical structure building for idioms (and also perhaps clichés, and fixed/frequent expressions) (Tabossi et. al, 2009; Arnon & Snider, 2010)
Implications: Lexical

• When there are no structural concerns, we see competition between the literal and idiomatic interpretations.

• Critically this is the case regardless of whether the string is actually ambiguous (*kick the bucket*) or unambiguous but semantically related (*kick the pail*).

• This is may be problematic for studies which use minimally different strings as literal controls.
Implications: *kick the pail*

- Further investigation is required with respect to the behavior of the *kick the pail* cases. (Related to the Double-take effect found by Gibbs, 1980?)
Implications

• Our results suggest that hybrid models make accurate predictions for idiom comprehension.

• Our results support a structural representation of idiomatic strings, and by extension perhaps other similar expressions.

• Our results do not support a purely lexical, word-like view of idioms.
Future Directions

• Do less global syntactic mismatches block idiom consideration? (Does the flexibility of the idiom matter?)

• What about cliche?

• Can phonologically related strings also invoke idiomatic consideration (e.g. kick the bag/rocket)?

• Do we obtain the same results in biased contexts?
Thank You

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Huettig and McQueen. (2007). The tug of war between phonological, semantic and shape information in language-mediated visual search. JML, 57 (4) pp. 460-482


The Idioms

kicked the bucket
tightened his belt
smelled a rat
found her feet
jumped the gun
know the ropes
pulling his leg
hit the hay
held her horses
pulling the strings
spilling the beans
hit the sack
Results at the Verb

Focus on 200ms post verb
Collapsed across lexical conditions
Looks for [ kick... The bucket/pail ] - Aligned to Verb

Proportion of Looks

Time in ms

Literal Advantage
Nothing Happening
Participants do not consider the idiomatic interpretation when the string spans a sentential boundary.

Clear preference for the literal interpretation.

Looks to the target words are not significantly higher than distractor level in the within sentence condition.

No clear preference for either the literal or idiomatic interpretation.