Effects of lifetime and fact knowledge in language comprehension

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Background Various forms of knowledge can rapidly affect language comprehension, such as who-does-what-to-whom (Kamide, Scheepers, & Altmann, 2003), what can be done with objects (Chambers, Tanenhaus, & Magnuson, 2004), and knowledge like the color of Dutch trains (Hagoort, Hald, Bastiaansen, & Peterson, 2004). Effects of world knowledge (e.g., the color of Dutch trains) resemble effects of lexical semantics (Hagoort et al., 2004) in EEG studies, each eliciting an N400 effect. Knowledge of a referent's lifetime (dead/alive) is, by contrast, integrated with temporal morphology in reading only at sentence end (Chen & Husband, 2018). The extent to which findings for rapid integration of world knowledge extend to biographical knowledge of individuals (e.g., alive or dead; biographical facts) has yet to be more fully explored.

Present Study The current study examines how specific biographical knowledge stored in long-term memory, prompted by a picture of a famous cultural figure, is integrated during processing of two types of information: temporal phrases (in relation to lifetime) and biographical information (in relation to biographical knowledge). The study thus informs theories of sentence processing about the integration of long-term knowledge of specific individuals: their lifetime (dead/alive) and biographical facts (e.g., starring in a certain film).

Procedure In an internet-based self-paced reading study (run on Ibex Farm), native German speakers (N = 160, aged 18-31) were presented pictures of famous cultural figures, half living and half dead (N = 24). After indicating whether they were familiar with the cultural figure, participants were presented with a fictional statement from the cultural figure (ex. 1) in which the cultural figure mentions in which year some accomplishment of theirs occurred (e.g., appearing in a film). Participants indicated whether the sentence was true given the picture preceding it. Critical items contained two two-level factors: *life-time congruence* (match vs. mismatch; at *year sentence* region) and *fact congruence* (match vs. mismatch; at *fact* sentence region), resulting in 4 conditions (full match, life-time mismatch, fact mismatch, or double mismatch). If long-term knowledge of lifetime and biographical facts of cultural figures are each rapidly integrated with language processing, we predicted *(i)* processing costs would be elicited from the year and fact regions in conditions containing the respective violations. We further predicted *(ii)* stronger effects for fact (e.g., song) than life-time (year) mismatches motivated by stronger effects for referential than non-referential relations in psycholinguistic research.

Results Post-trial responses (Fig. 1) indicated a main effect of life-time mismatch in accuracies (i.e., life-time mismatch + double mismatch vs. full match + fact mismatch): sentences containing lifetime violations received significantly higher accuracies than those that did not (z = -15.3, p < .001). Trials which received an incorrect response were excluded from reading time analyses. A main effect of *life-time mismatch* was found in the regions 'fact' (p < .05), fact+1 (p < .001), fact+2 (p < .001), name (p < .001), and the final region (p < .001). No main effect of *fact mismatch* was found, nor an interaction effect. Upon visual inspection of the reading times by condition (Fig. 2), this main effect of *life-time mismatch* resulted in shorter reading times for both the *life mismatch* and *double mismatch* conditions. Results are summarised in Table 1.

Summary and Conclusion The longer reading times for lifetime matches than mismatches (only) go against our expectations of *(i)* violations eliciting longer reading times, and *(ii)* a larger effect for fact mismatches than lifetime mismatches. It is possible the shorter reading times for life mismatches reflect explicit detection of the violation during comprehension, leading to 'speeding-up' in later regions, as participants had enough information to make the post-trial binary decision. The lack of a main effect of fact mismatch, despite a 73% rejection rate for the fact mismatch condition, could be attributed to later integration of specific biographical knowledge, which is more varied (singers release many songs) than lifetime knowledge (someone is either dead or alive). Predicting specific biographical knowledge effects during comprehension then seems to involve also modeling the multi-faceted and more or less variable nature of experience-based knowledge.

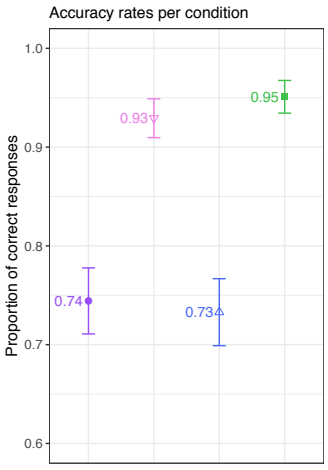
Example sentence

(ex1)	**„Im Jahr**	**2016 / 1968**	**habe ich**	**das Lied**	**‚Formation' / ‚Hey Jude'**
gloss:	*In the year*	*2016$_{match}$ / 1968$_{mismatch}$*	*I (have-aux)*	*the song*	*‚Formation'$_{match}$ / 'Hey Jude'$_{mismatch}$*
region:	(pre-year)	(year)	(year+1)	(year+2)	(fact)
	aufgenommen,"	**das verkündete**	**Beyoncé**	**gegenüber der Presse.**	
gloss:	*released,*	*announced*	*Beyoncé*	*to the press*	
region:	(fact+1)	(fact+2)	(name)	(final)	
translation:	"In the year 2016 / 1968, I released the song 'Formation / Hey Jude," Beyoncé told the press.				

Results

	fact			fact+1			fact+2			name			final			Responses	
	t =	*p* <	*d* =	*t* =	*p* <	*d* =	*t* =	*p* <	*d* =	*t* =	*p* <	*d* =	*t* =	*p* <	*d* =	*z* =	*p* <
Life	3.7	.05	.07	7.8	.001	.11	4.1	.001	.06	4.8	.001	.07	10	.001	.15	-15.3	.001
Fact																	
Inter.																	

***Table 1**: t-values (df = 147), p-values, and Cohen's* d *for reading times per region, and post-trial responses. Reading time p-values are Bonferroni corrected for multiple comparisons (multiplied by eight; once for each region analysed). Critical regions where effects were insignificant (i.e., t < 2, p > .05; regions 'year', 'year+1' and 'year+2') are omitted for visual simplicity. Responses: z-scores are reported (rather than t-values) and Cohen's* d *is omitted as it is not suitable for binomial data*



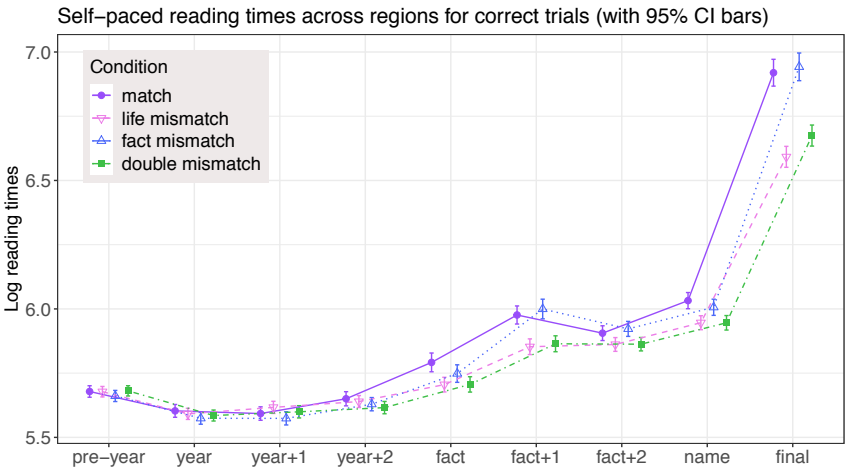


***Figure 1 (left)**: mean accuracies per condition (with 95% confidence intervals); conditions correspond to legend from Figure 2. N.B., 'accuracy' corresponds to proportion of acceptances for the full match condition, and rejections for all other conditions*
***Figure 2 (right)**: mean log-transformed self-paced reading times across sentence regions.*

References

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