Brief Report: Is syntax semantically constrained? Evidence from a grammaticality judgment study of Indonesian

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A central debate in the cognitive sciences surrounds the nature of adult speakers' linguistic representations: Are they purely syntactic (a traditional and widely-held view; e.g., Branigan & Pickering, 2017a), or are they semantically structured? A recent study (Ambridge, Bidgood, Pine, Rowland & Freudenthal, 2016) found support for the latter view, showing that adults' acceptability judgments of passive sentences were significantly predicted by independent semantic "affectedness" ratings designed to capture the putative semantics of the construction (e.g., *Bob was pushed by Wendy* is rated as more acceptable than *Bob was liked by Wendy*, as Bob is more affected in the former). However, because English lacks a separate topicalization construction which provides an alternative means of highlighting the patient (e.g., *BOB, Wendy kicked*), these findings have a possible alternative explanation: that highly affected entities are more likely to be *topicalized*, rather than *passivized per se*. Here we show that, in fact, Ambridge et al's (2016) finding replicates in Indonesian; a language with a topicalization construction. The present study therefore provides particularly compelling evidence that grammatical representations have semantic structure.

Keywords: Indonesian; linguistic representations; abstract syntax; passive; verb; semantics; autonomy of syntax;

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A central debate in psycholinguistics, and in cognitive science more generally, surrounds the nature of adult speakers' linguistic representations. Virtually all theories agree that adults possess some kind of abstract sentence-level representations that allow them to produce and understand utterances that they have never heard before (e.g., Pinker, 1989; Tomasello, 2003). For example, English speakers are generally held to have some kind of representation of a basic transitive structure ([SUBJECT] [VERB] [OBJECT]), which allows them to produce and understand sentences as simple and concrete as *The dog [S] chased [V] the cat [O]*, or as abstract and complex as *Party-hard Thailand [S] is going after [V] rehab tourists [O]* (a recent headline in The Jakarta Post).

A point of great contention, however is whether or not these syntactic representations contain semantic information. The traditional view (sometimes known as *autonomy of syntax*) is that they do not; that "grammar is autonomous and independent of meaning" (Chomsky, 1957[1]); that "syntactic representations do not contain semantic information" (Branigan & Pickering, 2017a); that "grammar is grammar, and usage is usage" (Newmeyer, 2003: 682). This claim may seem counterintuitive to readers who are not familiar with theories of psycholinguistics, but is invoked to explain the fact that sentences with identical syntactic (grammatical) structure can have very different meanings (e.g., *John is eager to please* vs *John is easy to please*; C. Chomsky, 1969) or even opposite meanings (e.g., *Bob is feared by Wendy* vs *Bob is frightened by Wendy*). The theoretical stakes are high because, if this position is correct, then learners must acquire knowledge of syntactic structure without the aid of semantics, and possibly with the aid of some form of innate knowledge.

The opposing view (e.g., Pinker, 1989; Kako & Wagner, 2001; Goldberg, 2006) holds that constructions (e.g., abstract sentence level patterns like [SUBJECT]

[1] With regard to the passive in particular, Chomsky (1993: 4) goes further, denying its existence an independent grammatical construction: "Constructions such as. . .[the] passive remain only as taxonomic artifacts, collections of phenomena explained through the interaction of the principles of UG, with the values of the parameters fixed.

[VERB] [OBJECT]) have meanings in and of themselves. For example, the semantics of the English passive construction ([SUBJECT] BE/GET [VERB] by [OBJECT]; e.g., *Bob was kicked by Wendy*) can be characterized as

> [B] (mapped onto the surface subject [of a passive]) is in a state or circumstance characterized by [A] (mapped onto the *by*-object or an understood argument) having acted upon it. Pinker, Lebeaux and Frost (1987: 249)

Under this latter approach, the acceptability or otherwise of hypothetical passive sentences varies as a function of the extent to which their semantics overlap with those of the abstract passive construction. For example, *Bob was kicked/frightened by Wendy* are both excellent passives, as Bob has been acted upon by Wendy, and changed state or circumstance as a result (the putative semantics of the construction). However, *Bob was heard by Wendy* is slightly infelicitous, as the semantic overlap is less than perfect. Utterances like *£5 was cost by the book* or *Five people are slept* by this tent (c.f., *The book cost £5*; *This tent sleeps five people*) are completely infelicitous, since the book or tent cannot easily be construed as acting upon the £5 or the five people. If this position is correct, then semantics may serve as a route into syntax after all, possibly obviating the need for innate grammatical knowledge.

A recent judgment study (Ambridge, Bidgood, Pine, Rowland & Freudenthal, 2016) provided some support for this claim (and confirmed the intuitions regarding acceptability set out in the preceding paragraph). Across 475 verbs (Study 2) and a subset of 72 "passivizable" verbs (Study 3), adults' acceptability judgments of passive sentences were significantly predicted by independent semantic "affectedness" ratings designed to capture Pinker et al's (1987) notion of passive semantics (Study 1). Although Ambridge et al (2016) did not observe a semantic effect for active sentences, this may have been due to a ceiling effect, since the vast majority of actives received acceptability ratings above 4.75/5 (see Fig. 3a, p.1449). In principle, such an effect is compatible with a semantics-based account, since the active transitive [SUBJECT] [VERB] [OBJECT] construction is also prototypically associated with "affecting" semantics, involving "a volitionally acting 'agent' participant performing a concrete, dynamic action which has a perceptible and lasting effect on a specific 'patient'" (Næs, 2007 :15; see also Hopper & Thompson, 1980). Thus, sentences such as *Wendy kicked/frightened Bob* might in principle be expected to receive slightly

higher ratings than sentences such as *Wendy heard Bob* (see also Hartshorne, Pogue & Snedeker, 2015). Indeed, many comprehension studies in the "syntactic-bootstrapping" literature provide evidence not only for the existence of this particular semantics-syntax link, but for its early acquisition (e.g., Naigles, 1990; Naigles, Fowler & Helm, 1992; Naigles, Gleitman & Gleitman, 1993; Gertner, Fisher & Eisengart, 2006; Noble, Rowland & Pine, 2011; Ambridge, Noble & Lieven, 2014).

The findings of Ambridge et al (2016) therefore provide support for a *semantics-based* account of the passive over a semantics-free *autonomy of syntax* account. Currently, however, this support is limited as – to our knowledge – this is the only study showing such effects using a judgment paradigm. (Messenger, Branigan, McLean & Sorace, 2012, find no effect of semantics in a passive priming task; but such binary production tasks are less well suited than graded judgment tasks to detecting fine-grained semantic differences). This support is also limited to a single language: English.

As a relatively rigid word-order language, English is typologically rather atypical in a respect that may be particularly crucial when investigating the semantics (or lack thereof) of the passive construction. The English passive serves the discourse function of foregrounding the undergoer (e.g., PATIENT) of the action, at the expense of the instigator (e.g., AGENT); e.g., *BOB was kicked by Wendy*. Crucially, unlike many languages, English does not have an everyday topicalization construction which also fulfils this function; only very low-frequency and highly-marked circumlocutions such as *As for Bob, Wendy kicked him; It was Bob that Wendy kicked* or *BOB, Wendy kicked*. This raises the possibility that apparent verb semantic effects on the passive arise not because this construction has the semantics of affectedness per se, but because highly affected entities are most likely to be topicalized (e.g., *Bob was run over by a bus*), and – in English – the passive construction provides the only readily-available means for doing so[2]. On this account, apparent effects of passive semantics, and what English speakers are responding to in a judgment task, are – to adopt Newmeyer's (2003) dichotomy – facts about *usage*, not about *grammar* or syntax.

[2] Why are highly-affected entities (e.g., PATIENTS) more likely to be topicalized into sentence-initial position? Because highly affect*ing* entities (e.g., AGENTS) are *already* in sentence-initial position in canonical English (and Indonesian) SVO active sentences.

The solution to this problem is to investigate whether the effect of passive semantics observed by Ambridge et al (2016) holds for a language that has a topicalization construction which provides an alternative means of foregrounding highly affected entities (e.g., *BOB, Wendy kicked*). Indonesian is one such language, and provides an ideal comparison with English, because it is similar in both its use of SV(by)O word order in actives and passives, and its relatively impoverished inflectional morphology (i.e., neither SUBJECT or OBJECT receive case marking).The Indonesian topicalization construction (e.g., *BOB, Wendy kicked*) is often referred to as the "noncanonical passive" or "object voice" (e.g., Cole, Hermon & Yanti, 2008), because it uses patient-first word order, but neither the passive marker on the verb (*di*) nor *oleh* ('by') introducing the agent.

To briefly sketch some relevant grammatical properties of the language, Indonesian (a register of Malay, an Austronesian language) differs from Indo-European languages (such as English) in that verbs are not marked for person (e.g., *I play* vs *He play**s***), number (*He **is** playing* vs *They **are** playing*) or tense (e.g, *He play**s*** vs *He play**ed***). A difference that is particularly relevant for the present study is that, in Indo-European languages (and many other families), active sentences constitute the basic "unmarked" type, with passives requiring additional morphological marking:

Active: The mother is kicking the father
Passive: The father is **being** kick**ed** by the mother

However, in Indonesian/Malay, neither the active nor the passive constitutes a basic unmarked type; the verb must be prefixed with either the active marker (some form of *meng-*) or the passive marker (*di-*)

Active:	Ibu **men**endang ayah	Mother ACTIVE-kick father
(Canonical) Passive:	Ayah **di**tendang oleh ibu	Father PASSIVE-kick mother

Rather unusually, from a global typological perspective, the bare unmarked form of the verb (here *tendang*, 'kick') surfaces not in canonical active or passive sentences, but in noncanonical passives:

Noncanonical passive:	Aya, ibu **ø-**tendang	Father, mother kicked

To summarize the predictions of the present study, on the assumption that genuine, canonical passive constructions share at least some crosslinguistic similarity (whether due to syntactic and/or semantic universals), we would expect to see the semantic effect previously observed for the English passive to hold for the Indonesian canonical passive, but not – or to be significantly reduced – for the Indonesian non-canonical pseudo-passive (on the assumption that if she *intends* to convey affectedness of the subject – rather than simply topicalization – an Indonesian speaker will use a canonical passive instead). If, for whatever reason, Indonesian-speaking adults do not show a ceiling effect for ratings of active sentences (as English-speaking did in Ambridge et al, 2016), we can also test the prediction of a similar – though perhaps smaller – effect for actives, which are also prototypically associated with high semantic affectedness.

Method

Ethics. The study was approved by the Udayana University Ethics Committee. All participants gave informed consent.

Participants. Participants were 76 native Indonesian-speaking adults (university students at Udayana University, Bali), 60 of whom completed the main grammaticality judgment study, and 16 the semantic ratings task. It was not possible to recruit monolingual speakers; most can be assumed to have had at least some exposure to English and Balinese.

Grammaticality Judgment Task. Participants completing the grammaticality judgment task rated a canonical passive sentence, a noncanonical passive sentence and an active sentence for each of 72 verbs (translations of those used in Ambridge et al, 2016), using a 5-point smiley-face sale. These verbs were originally chosen on the basis that they are passivizable, reversible and relatively easily depictable. As in Ambridge et al (2016), before making each judgment, the participant watched a short animation indicating the intended meaning. For any given verb, the same characters featured in the canonical passive, noncanonical passive and active versions of each sentence, as in the examples below, and the cartoon shown was identical.

Canonical passive:	Ayah ditendang oleh ibu	Father kicked by mother

Noncanonical passive:	Aya, ibu tendang	Father, mother kicked
Active:	Ibu menendang ayah	Mother kicked father

The generic terms father, mother, boy and girl were used instead of – in Ambridge et al (2016) – names of British and American cartoon characters, as we assumed these characters would be less familiar to the present participants; though the animations themselves were not changed. Trial order was pseudorandomized, as per the relevant counterbalance list, such that the same verb never appeared in consecutive trials.

Semantic ratings Task. Participants completing the semantic rating task completed an Indonesian translation of the spreadsheet used in Ambridge et al (2016), in which participants were asked to rate each of the 72 verbs, on a 1-9 scale, for the extent to which they exhibit each of 10 semantic properties, designed to capture Pinker et al's (1987) notion of semantic affectedness:

> (a) A causes (or is responsible for) some effect/change involving B, (b) A enables or allows the change/event, (c) A is doing something to B, (d) A is responsible, (e) A makes physical contact with B, (f) B changes state or circumstances, (g) B is responsible [predicted to have a negative relationship with passivizability], (h) It would be possible for A to deliberately [VERB] B, (i) The event affects B in some way, (j) The action adversely (negatively) affects B.

In order to guard against the possibility that participants might use relative passivizability as a criterion for completing the semantic rating task, we ensured that no passives were used or mentioned in the task itself or the description of the study. As in Ambridge et al (2016) Principle Components Analysis ('principal' from the R package 'psych'; Revelle, 2018) was used to collapse the mean semantic feature ratings (across all 16 raters) into a single composite measure of passive-consistent semantics.

Frequency counts. A potential concern is that participants' acceptability judgments may reflect the relative frequency of particular verbs in passive and active constructions. In order to allow for these potential confounds to be controlled for in the statistical analysis, we obtained counts of each of the 72 verbs in canonical passive and active constructions in Levshina's ParTy subtitle corpus

(http://www.natalialevshina.com/corpus.html), which contained no noncanonical passive forms. A custom-written computer program was used to extract all forms of each verb, which were then hand coded. Both counts were natural log N+1 transformed.

Statistical analyses. We adopted a Bayesian approach to model building which offers four important advantages. First, frequentist mixed-effects models would not converge with anything approaching maximal random effects structure, and so risk anticonservatism (Barr, Levy, Scheepers & Tily, 2013). Second, a Bayesian approach allows us to incorporate a prior from a very similar English study (Ambridge et al, 2016, Study 3): M=0, SD=0.41, the largest fixed effect observed in this previous study, the effect of sentence type: passive vs. active). No scaling or centering was used, in order to keep all variables on the same scale as this previous study. Third, Bayesian models yield "p" values (actually, *pMCMC* values) and credible intervals that, unlike their frequentist counterparts, can be interpreted intuitively: The *pMCMC* value represents the probability that the true size of the effect is (for positive effects) zero or lower (for negative effects, zero or higher). The 95% credible interval represents an interval which contains, with 95% probability, the true value of the effect in question. Fourth (and relatedly), Bayesian models can provide positive evidence for the *lack* of an effect – in the form of a mean effect size centered about zero – in a way that frequentist null hypothesis testing cannot (Dienes, 2014).

All analyses were run using the 'brms' R package (Bürkner, 2016). All data and code can be found on the website of the Open Science Framework at https://osf.io/6a8gj/. The syntax for the main model was as follows:

```
fit1 <- brm(formula = rating.response ~ (1 + type*PCA1 +
type*Total_Active_Freq + type*Total_Passive_Freq|participant) + (1 +
type|verb) + type*PCA1 + type*Total_Active_Freq +
type*Total_Passive_Freq, data = Adults, family =  gaussian(),
set_prior("normal(0,0.41)", class = "b"), warmup = 2000, iter = 5000, chains =
1, cores=4, save_all_pars = F, control = list(adapt_delta = 0.90))
```

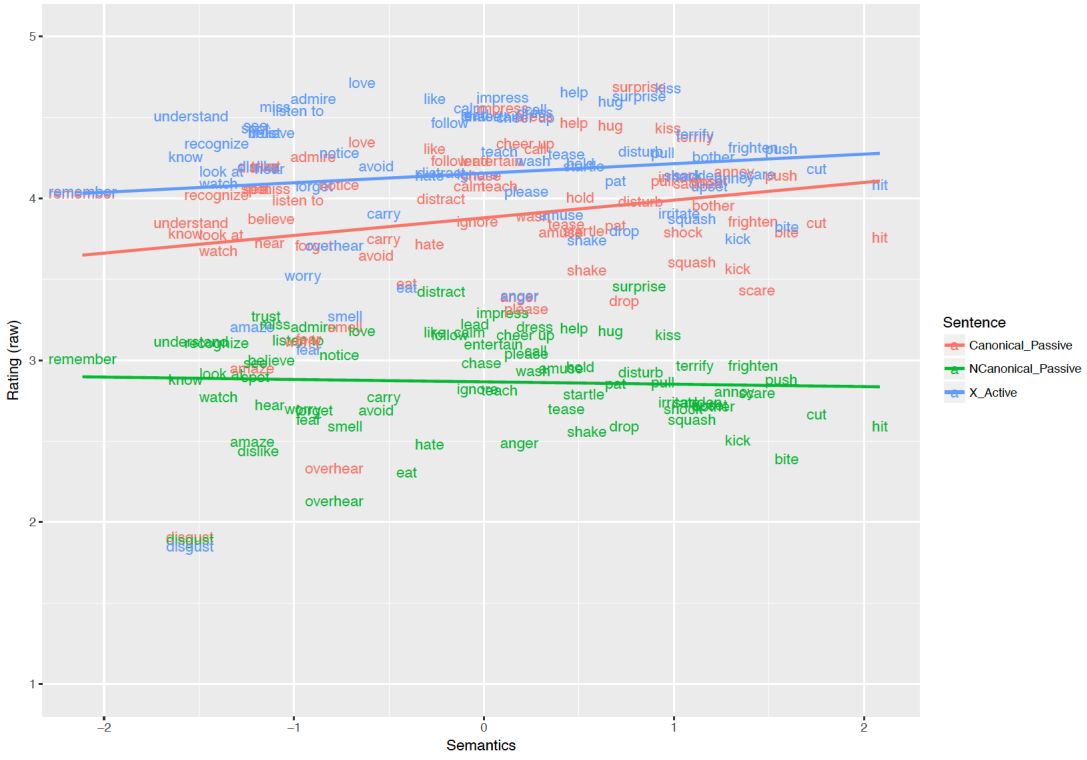
Note that we did not quite use a fully maximal random structure, in that only two-way interactions were included as by-participant random slopes. Including higher order

interactions prevented the model from converging within a reasonable time frame (and, in terms of the corresponding fixed effects, the theoretical predictions under investigation relate only to main effects and two-way interactions). We report only simultaneous models, without residualization, which demonstrate the effect of each main effect (or interaction) above and beyond all the other predictors included in the model (e.g., Wurm & Fisicaro, 2014). Inspection of raw correlations suggested no problematic collinearity between the semantic predictor of interest and the control predictors of active frequency (r= -.28) and passive frequency (r= - .24).

Results

Fig. 1 plots the composite semantic affectedness predictor (x axis) against the mean ratings for each verb (shown in English translation) in canonical passive, noncanonical passive and active sentences (y axis).

***Fig1*. Sentence acceptability ratings on the 5-point scale (y axis) as a function of semantic affectedness (x axis).**



Inspection of Fig. 1 suggests that, as predicted by a semantics-based approach, these data indicate a semantic effect for canonical passives (red) and actives (blue), but not

for noncanonical passives (green). Although the correlation appears modest, it is important to bear in mind that all verbs were selected to be – in a binary sense – "grammatical" in all three sentence types, and hence, within each sentence type, there is relatively little by-verb variance in ratings for the semantic predictor to explain.

Indeed, in addition to a main effect of semantics (M=0.12 [-0.01, 0.24], $pMCMC$=0.034), a full, all-sentences model (see Table 1) yielded strong evidence for a negative interaction of semantics by noncanonical passives, such that – as predicted by a semantics-based approach – the effect of semantic affectedness was larger for canonical passives (the reference category) than for noncanonical passives (M= -0.13 [-0.20, -0.06], $pMCMC$=0). Separate models for each sentence type (see Tables 2-3) confirmed strong (97.5%) evidence for a nonzero effect of semantic affectedness on ratings of canonical passives (M=0.13, [0.00, 0.25], $pMCMC$=0.025), but not noncanonical passives (M=-0.01 [-0.10, 0.09], $pMCMC$=0.43), for which the credible interval was almost exactly symmetrical about zero, providing some positive evidence for a null effect.

Table 1. Model for all sentence

Fixed effect	Estimate	Est.Error	l-95% CI	u-95% CI	Eff.Sampl	Rhat	pMCMC	%>0 / %<0
Intercept	3.83	0.08	3.67	3.98	279	1.000	0.000	100
Sentence = Noncanoncial Passive (vs Canonical Passive)	-0.93	0.10	-1.12	-0.75	235	1.000	0.000	100
Sentence = Active (vs Canonical Passive)	0.26	0.05	0.16	0.36	613	1.000	0.000	100
Semantics	0.12	0.06	-0.01	0.24	374	1.000	0.035	97
Active Frequency	0.08	0.14	-0.18	0.35	1079	1.000	0.290	71
Passive Frequency	-0.06	0.31	-0.66	0.53	919	1.000	0.427	57
Sentence = Noncanonical Passive * Semantics	-0.13	0.04	-0.20	-0.06	565	1.000	0.000	100
Sentence = Active * Semantics	-0.04	0.03	-0.10	0.02	889	1.000	0.081	92
Sentence = Noncanonical Passive * Active Frequency	-0.05	0.10	-0.25	0.17	1300	1.000	0.305	70
Sentence = Active * Active Frequency	0.06	0.10	-0.14	0.26	1293	1.000	0.294	71
Sentence = Nonanonical Passive * Passive Frequency	0.03	0.23	-0.45	0.45	1306	1.000	0.446	55
Sentence = Active * Passive Frequency	-0.10	0.23	-0.54	0.35	1297	1.000	0.327	67

Table 2. Model for canonical passives only

Fixed effect	Estimate	Est.Error	l-95% CI	u-95% CI	Eff.Sampl	Rhat	pMCMC	%>0 / %<0
Intercept	3.86	0.08	3.70	4.02	243	1.000	0.000	100
Semantics	0.13	0.07	0.00	0.25	360	1.000	0.025	98
Active Frequency	0.09	0.14	-0.20	0.36	1162	1.000	0.263	74
Passive Frequency	-0.09	0.32	-0.71	0.54	1099	1.000	0.393	61

Table 3 . Model for noncanonical passives only

Fixed effect	Estimate	Est.Error	l-95% CI	u-95% CI	Eff.Sampl	Rhat	pMCMC	%>0 / %<0
Intercept	2.86	0.11	2.66	3.07	100	1.000	0.000	100
Semantics	-0.01	0.05	-0.10	0.09	362	1.010	0.432	57
Active Frequency	0.05	0.12	-0.20	0.28	701	1.010	0.337	66
Passive Frequency	-0.07	0.28	-0.61	0.50	681	1.020	0.386	61

Table 4. Model for actives only

Fixed effect	Estimate	Est.Error	l-95% CI	u-95% CI	Eff.Sampl	Rhat	pMCMC	%>0 / %<0
Intercept	4.13	0.08	3.96	4.30	252	1.000	0.000	100
Semantics	0.08	0.07	-0.05	0.22	362	1.000	0.098	90
Active Frequency	0.11	0.15	-0.20	0.40	961	1.000	0.225	78
Passive Frequency	-0.12	0.34	-0.76	0.56	1000	1.000	0.353	65

Note: Rows highlighted in grey are those discussed in the main text

The full, all-sentences model (see Table 1) also yielded weaker evidence for a negative interaction of semantics by actives, such that – consistent with Ambridge et al (2016) – the effect of semantic affectedness appeared to be slightly larger for canonical passives (the reference category) than actives (*M*= -0.04 [-0.10, 0.02], *pMCMC*=0.08). (It is important to bear in mind that although a frequentist *p* value of 0.08 would not be deemed "statistically significant", a Bayesian *pMCMC* value of 0.08 corresponds to a 92% probability of a nonzero effect). Indeed, separate models for each sentence type (see Tables 2 and 4) yielded strong (97.5%) evidence of a semantic effect for canonical passives (*M*=0.13, [0.00, 0.25], *pMCMC*=0.025), and only weak evidence (90%) for actives (M=0.8 [-0.05, 0.22], *pMCMC*=0.098); though note that the credible intervals largely overlap.

In summary, as predicted by a semantics-based account, the present study revealed an effect of semantic affectedness on judgments of canonical passive

sentences (and also active sentences, though possibly to a slightly lesser extent) but – crucially – not noncanonical passive sentences.

Discussion

A previous judgment study (Ambridge et al, 2016) found evidence for a semantic affectedness constraint on the passive proposed by Pinker et al (1987). Across 72 verbs (Study 3), adults' acceptability judgments of passive sentences were significantly predicted by independent semantic ratings designed to capture the notion of affected semantics held to be characteristic of the passive construction (and also – perhaps to a lesser extent – the active transitive construction; e.g., Hopper & Thompson, 1980; Næs, 2007). A potential concern, however, is that the apparent semantic effect in this previous study may have in fact been an effect of topicalization (e.g., "Bob" might be more likely to be topicalized in a scenario where he is "kicked/frightened by Wendy" than merely "seen/heard" by Wendy). Since English lacks a separate topicalization construction, passivizability and potential topicality were perfectly confounded in this previous study.

In the present study, we sought to address this potential confound by conducting a similar version of Ambridge et al's (2016) study in Indonesian, adding – as a control – nonpassive (i.e., pseudo or noncanonical passive) forms. As predicted by a semantics-based account, we replicated the English finding of a semantic effect for passives but, crucially, found no such effect for these nonpassive forms. We also found a similar (though perhaps slightly smaller) effect for actives; a finding that is also consistent with a semantics-based account, but was not observed by Ambridge et al (2016), probably due to a ceiling effect for ratings of active sentences.

Taken together with the findings of Ambridge et al (2016), the present findings constitute strong evidence for the claim that, counter to the traditional view, syntactic representations – in this case the passive – do contain semantic information. One possible objection (Newmeyer, 2018), that apparent semantic effects apply only when the SUBJECT is not an argument of the verb (e.g., £5 was cost by the book), does not apply to either the present study or to Ambridge et al (2016): In both cases, both characters were arguments of the verb (indeed, all passives were reversible). A second possible objection, that apparent semantic effects on the passive are in fact topicalization effects in disguise, is ruled out by the present study: Semantic effects in

Indonesian were observed for the canonical passive, but not the topicalization construction.

A third possible objection to our conclusion that syntactic representations contain semantic information is raised by Branigan and Pickering (2017b: 50) who, with reference to the study of Ambridge et al (2016) suggest that judgment data cannot be used to investigate the question in hand since "acceptability judgments are affected by semantic factors, a point that reinforces our conclusion that acceptability judgments do not straightforwardly reflect syntactic representation". This argument suffers from a degree of circularity: Any task that suggests effects of semantics on syntactic representations cannot actually be tapping into syntactic representations, because we know *a priori* that there are no effects of semantics on syntactic representations. That said, we do accept Branigan and Pickering's (2017b) general point that acceptability judgments are affected by other factors that are difficult to control, including frequency and the plausibility/typicality of the event described. However, it is worth noting that Ambridge et al (2016, Study 4) report similar findings based on a timed forced-choice animated picture-matching comprehension task, to which Branigan and Pickering's (2017) objection regarding judgment studies does not apply.

Of course, it would be premature to draw sweeping conclusions on the basis of just two studies. But if the findings of Ambridge et al (2016) and the present study are replicated in other languages and using other methodologies – particularly Branigan and Pickering's (2017a) favoured method of production priming – this would, we suggest, constitute powerful evidence against the claim that "syntactic representations do not contain semantic information" (Branigan & Pickering, 2017a).

For now, the position is that, at least for the passive, semantic effects have been observed using two different paradigms within a single language (Ambridge et al, 2016) and vice versa (the present study). This raises the question of what kind of theoretical account can explain these findings. We can see two possibilities.

The first is a prototype account under which learners form and store a prototype passive construction (or, indeed, an active transitive construction) by abstracting across exemplars of the construction that they hear in their input (e.g., Abbot-Smith & Tomasello, 2006). This prototype construction has what Schlesinger (1981: 241) calls the "semantic flavour" of the construction. Since most passive utterances that learners hear involve a highly affected patient being acted upon by an

agent, the abstract passive prototype that learners form will also exhibit these semantics (and likewise for the active transitive construction). Indeed, although the lexical-functional-grammar account developed by Pinker et al (1987; Pinker, 1989) is often seen as at-odds with this construction-based approach, Pinker (2013: xv) in fact describes his account as "upward compatible with…various versions of Construction Grammar, such as those developed by Ronald Langacker, Adele Goldberg and William Croft", noting that "my notion of the 'thematic core' of an argument structure, which delineates…verbs compatible with that argument structure is very close to the idea of a 'construction meaning' invoked by theories of construction grammar".

The second possibility is an exemplar-based account under which learners do not form or store a separate construction prototype (e.g., Ambridge, submitted). Rather, they simply store all the passive utterances that they hear, and produce, comprehend or judge novel passives by on-the-fly analogy across these stored passive utterances, weighted according to their similarity to the target. Since most passive utterances that learners hear involve a highly affected patient being acted upon by an agent, these are the types of stored passives that are most available when learners recruit stored forms for on-the-fly analogy (and likewise for active transitive forms).

There is no room here to explore the relative merits of prototype and exemplar-based accounts of language acquisition (see Abbot-Smith & Tomasello, 2006; Ambridge, submitted, for opposing views). Indeed, this debate is not fully resolved in the general categorization literature (e.g., see Love, 2013, for a particularly illuminating and balanced review). Future studies will be needed to mediate between these two possibilities.

In the meantime, whether a prototype- or exemplar-based account (or some other type of account) turns out to be correct, the findings of the present study provide compelling evidence against accounts that posit the absence of semantic information in speakers' syntactic representations. Even when their language offers alternative means of topicalizing particular entities, as for speakers of Indonesian, semantic compatibility between the particular verb and the passive construction itself is an important determinant of the acceptability of the resulting utterance.

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