INTERNATIONAL REVIEW OF SOCIAL PSYCHOLOGY

Mierop, A., et al. (2020). Cognitive Load Impairs Evaluative Conditioning, Even When Individual CS and US Stimuli are Successfully Encoded. *International Review of Social Psychology*, 33(1): 3, 1–7. DOI: https://doi.org/10.5334/irsp.339

RESEARCH ARTICLE

Cognitive Load Impairs Evaluative Conditioning, Even When Individual CS and US Stimuli are Successfully Encoded

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Cognitive load has been shown to reduce both Evaluative Conditioning (EC) effects and CS-US pairing memory. This suggests the successful encoding of CS-US pairings is required for eliciting EC effects. However, an alternative account may be that cognitive load impairs the encoding of individual CS or US stimuli in the first place. We examined this possibility by manipulating the presence or absence of an auditory two-back task at learning, and by measuring the memory for *both* individual CS and US stimuli and for their pairings. Cognitive load reduced memory for CSs, USs, and CS-US pairings. Of importance, however, it disrupted EC even when the encoding of individual CSs and USs composing a pair was preserved. A mediation analysis also supported the assumption cognitive load reduces EC effects because it hampers the encoding of CS-US relations. This confirms the encoding of CS-US relation is a critical, yet non-efficient, contributor to EC.

Keywords: evaluative conditioning; associative learning; automaticity; efficiency; attitudes

Introduction

Evaluative Conditioning (EC) consists of a change in the valence of conditioned stimuli (CS) following their pairing with valent stimuli (unconditioned stimuli, or USs). The EC procedure has been regularly used for testing the automaticity of attitude formation (for a recent review, see Corneille & Stahl, 2019). Automaticity refers to four operating conditions: (1) unawareness of the CS-US pairings, (2) efficiency, (3) goal-independence, and (4) uncontrollability (Bargh, 1994). In this research, we focus on the second one: efficiency (i.e., the possibility for the process to operate with minimal attentional resources) (Bargh, 1994). If EC relies on an efficient learning process, then it should be observed even when cognitive resources are depleted at encoding.

Against the efficiency view, previous research indicates the EC effect as well as memory of CS-US pairings are drastically reduced, often to non-significance, under cognitive load conditions (Dedonder et al., 2010; Mierop, Hütter & Corneille, 2017; Pleyers et al., 2009). As cognitive load was implemented during participants' exposure to the CS-US pairs in these experiments, the availability of cognitive resources appears necessary for the successful encoding of CS-US pairings and, presumably as a result, for the establishment of an EC effect. CS-US relations encoding would thus be a critical, yet non-efficient, process in the establishment of EC effects.

Importantly, this account assumes load hampers the encoding of the CS-US relation while it preserves the encoding of the individual CS and US stimuli that compose CS-US pairs. This assumption has not been tested yet, despite its importance. That is, should load impact the very encoding of individual stimuli, then the effect of load on EC would not conclusively speak to the efficiency of attitude acquisition. Rather, it would speak to the efficiency of the encoding of individual CS and US stimuli.

Blask, Walther, Halbeisen, and Weil (2012) correctly pointed out that a secondary task may prevent the encoding of the individual stimuli. Consistent with this, Halbeisen and Walther (2015) observed EC but not CS-US pairing memory resists a load manipulation when the load materials rely on a different modality than CS-US materials. These authors concluded EC can be established through an efficient encoding of the individual stimuli entering CS-US pairs, despite the unsuccessful encoding of the CS-US relation. Results from that experiment, however, are at odds with many other experiments that failed to find efficient EC effect without CS-US memory when *also* relying on dissimilarity conditions (e.g., Dedonder, 2010; Mierop et al., 2017).

Also consistent with the importance of encoding CS-US relations in EC effects is an experiment by Kattner (2012). This author observed no EC when participants' attention was directed to individual CS and US stimuli but was diverted from their pairings. Importantly, however, this research manipulated the *focus* of attention by using a *processing goals* modification. As was also the case in other experiments manipulating processing goals (e.g., Gast & Rothermund, 2011), participants were instructed to pay attention to irrelevant pairings (i.e., links of each CS and US with a random digit). Hence, this research speaks to goal-dependency (see also Corneille et al., 2009;

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Gast & Rothermund, 2011; Stahl, Haaf & Corneille, 2016; Verwijmeren et al., 2012), not to efficiency. Because automaticity features do not perfectly overlap with each other (Melnikoff & Bargh, 2018; Moors & De Houwer, 2006), the goal-dependency of EC does not imply EC is non-efficient.

To advance our understanding of the efficiency of attitude learning, we examined whether attitude formation is observed in an evaluative conditioning procedure when the encoding of individual CS and US stimuli is successfully achieved but the encoding of their pairing is not. This was investigated by manipulating the presence or absence of an auditory two-back task at encoding and by measuring the memory of individual CS and US stimuli, as well as of their pairing. Based on growing evidence questioning automatic attitude learning (Corneille & Stahl, 2019), we predicted we would replicate the findings that cognitive load (1) reduces EC and (2) weakens CS-US pairings memory. In addition, we (3) tested whether cognitive load preserves the memory of individual CS and US stimuli entering CS-US pairings and (4) examined whether EC effects are reduced in the load condition when memory for individual CS and US memory is preserved. Mediational analyses were additionally conducted to determine if the load effect on EC was mediated by participants' memory for individual CSs and USs and CS-US relations.

Method

We report how we determined our sample size, all data exclusions, all manipulations, and all measures. The pre-registration, program script, raw data, and analytic script are publicly available on Open Science Framework (osf.io/g9wds).

Participants

Eighty-one undergraduate students participated in the experiment (58 women, 23 men, M_{age} = 20.49, SD_{age} = 1.91). They were randomly assigned to a control (N = 41) or load (N = 40) condition. The 'pwr.f2.test' function of the 'pwr' package (Champely et al., 2013) in R (R Development Core Team, 2017) determined this sample size allows for detecting with a statistical power of $(1-\beta) = 0.8$ and a Type I error probability of $\alpha = 0.05$ effect sizes as low as $\eta^2_p = 0.09$, which is an intermediate effect size according to Cohen's (1988) norm. In an Integrative Data Analysis conducted on data from three experiments, Mierop and colleagues (2017) observed the overall effect of load on EC is of intermediate size ($\eta^2_p = 0.08$).

Procedure and Material

The experiment was programmed with EPrime 2.0. Participants went through three phases. In the first—conditioning—phase, eight CS-US pairs were presented seven times, each for 1000 ms, in a random order. The CSs represented neutral consumption products (e.g., chewing-gums); whereas, the USs were pictures taken from the International Affective Picture System (IAPS, Lang, Bradley & Cuthbert, 1997). Four CSs were paired with negative USs (IAPS references 2715, 2750, 6360, 6561, 2550, 4603, 4641, 8120) and four CSs were paired with positive USs (IAPS references 4608, 4700, 8200, 8460, 2141, 2900.1, 6315, 6510; CS-US pairings were counterbalanced across participants). At the trial level, a CS was presented at the bottom center of the screen; whereas, the US was simultaneously presented in the background. During this conditioning phase, half of the participants had to perform an auditory two-back task involving numeric information communicated via headphones and responses produced on a keyboard (for a description of the procedure, see Pleyers et al., 2009).

In a second—evaluation—step, participants were invited to rate the CSs. In addition to the eight CSs that were presented during the conditioning phase, eight additional CSs were included in this evaluation phase (previously and newly presented CSs were counterbalanced across participants). In this evaluation phase, participants had to rate each of the 16 CSs on a scale ranging from 1 (very negative) to 9 (very positive).

In a third—memory probe—step, we added 8 filler USs in addition to the 8 filler CSs that were not presented in the conditioning phase (old vs new USs were also counterbalanced across participants), resulting in 16 CSs and 16 USs in the 2 subsequent memory tasks. Participants were first asked for each of the 16 CSs and 16 USs to report if (1) it was presented during the conditioning phase, (2) it was not presented during the conditioning phase, or (3) they do not remember.

Finally, for each of the 16 CSs, participants were asked to identify which of the 16 USs was paired with the CS. On each trial, participants had the opportunity to answer that they did not remember. Memory for individual CSs and USs was probed before CS-US pairing memory to avoid confusions (e.g., participants reporting they saw a given CS that was not presented during the conditioning phase because it was presented in the pairing memory phase).

Results

Analytical strategy

Data were analyzed using the ezANOVA, anovaBF, and lmBF functions (from the 'ez' and the 'BayesFactor' packages, (Lawrence, 2016; Morey, Rouder & Jamil, 2015) in R (R Development Core Team, 2017). We report the Bayes factors associated with the model comparison made in the frequentist analyses.[1] An augmented model containing the tested factor was compared to a constrained model not containing this factor. The Bayes factors in favor of the alternative hypothesis (or BF10) are presented when the conventional p-value of 0.05 is encountered. The Bayes factors in favor of the null hypothesis (or BF01) are reported when the p-value is above this threshold.

Evaluative ratings

The evaluative ratings of the CSs were averaged by participants and by US valence. These ratings were submitted to a 3 (US valence: positive, negative, none) × 2 (Depletion condition: Load, Control) repeated measures ANOVA, with the first factor manipulated within-participants and the second between-participants (see **Figure 1A**). This analysis revealed a main effect of US valence, $F(2,158) = 10.51$, $p < 0.001$, Generalized partial Eta-Squared (η^2_g) = 0.08, BF10 = 794.18 ± 5.55%. Attesting of an EC effect,

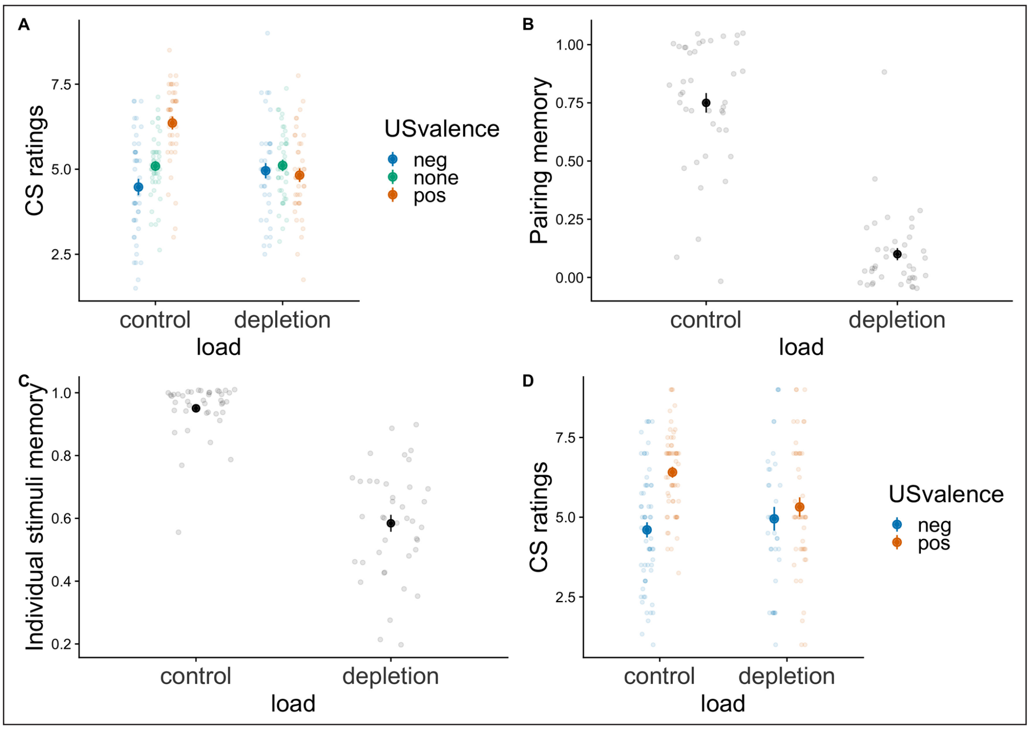

Figure 1: Effects of the load manipulation on CS ratings **(A)**, pairing memory **(B)**, individual stimuli memory **(C)**, and CS ratings provided correct memory of individual CS and US stimuli **(D)**. Individual data points are represented with dots and are summarized through their observed means, as well as their standard errors around the means.

positive CSs (M = 5.60, SD = 1.45) were preferred to neutral CSs (M = 5.10, SD = 0.99, $t(80) = 2.89$, $p = 0.005$), which tended to be preferred to negative CSs (M = 4.71, SD = 1.49, $t(80) = 1.87$, $p = 0.06$). A main effect of Depletion was also observed, $F(1,79) = 4.30$, $p = 0.04$, $\eta^2_g = 0.02$, BF10 = 0.88 ± 4.52%. Although inconclusive in the Bayesian framework, CSs were less positively evaluated in the load (M = 4.96, SD = 1.25) than in the control (M = 5.31, SD = 1.48) condition.

More importantly, the analysis yielded a US valence × Depletion interaction, $F(2,158) = 14.78$, $p < 0.001$, $\eta^2_g = 0.11$, BF10 > 1000. The simple effect of US valence was observed in the control condition, $F(2,80) = 23.24$, $p < 0.001$, $\eta^2_g = 0.28$, BF10 > 1000, but not in the depletion condition, $F(2,78) = 0.58$, $p = 0.56$, $\eta^2_g = 0.01$, BF01 = 7.75 ± 1.17%. Consistent with previous research, the EC effect was reduced to non-significance when cognitive load was implemented at learning.

Load effect on CS-US pairing memory

We computed an accuracy score for the memory of the CS-US pairings. Correct responses were coded '1'; whereas, incorrect responses and 'don't know' responses were coded '0' at the item-level. We computed the proportion of correct responses for each participant. These proportion scores were submitted to a t-test as a function of the Depletion condition (see **Figure 1B**). Contingency memory was higher in the control (M = 0.75, SD = 0.27) than the depletion (M = 0.1, SD = 0.16, $t(79) = 13.14$, $p < 0.001$, $\eta^2_g = 0.69$, BF10 > 1000) condition. Hence, again consistent with previous research, cognitive load strongly reduced CS-US pairing memory.

Load effect on the memory of individual CSs and USs

To probe the memory of the individual stimuli, we computed an accuracy score for the memory of the individual CSs and USs after coding them into one of four possible categories: true positive (an old stimulus reported as old), false positive (a new stimulus reported as old), true negative (a new stimulus reported as new), and false negative (an old stimulus reported as new). We computed an accuracy score for each participant with the following formula:

$$\frac{(True\ positives + True\ negatives)}{(True\ positives + True\ negatives + False\ positives + False\ negatives)}$$

Memory accuracy was submitted to a t-test as a function of the load condition (see **Figure 1D**). It was higher for participants in the control condition (M = 0.95, SD = 0.08) than in the depletion condition (M = 0.58, SD = 0.17, $t(79) = 12.29$, $p < 0.001$, $\eta^2_g = 0.66$, BF10 > 1000). Cognitive load thus substantially reduced memory accuracy for individual CS and US stimuli composing a pair.

Evaluative effects of load on correctly retrieved individual CSs and USs

We examined the role of US valence and Depletion condition on the evaluation of the subset of correctly retrieved[2] individual CS and US stimuli. We observed a US valence × Depletion interaction, $F(1,73.22) = 5.96$, $p = 0.02$, $\eta^2_g = 0.06$, BF10 = 6.01 ± 7.45%. EC was observed in the control condition, $F(1,38.27) = 31.81$, $p < 0.001$, $\eta^2_g = 0.44$, BF10 > 1000, but not in the depletion condition, $F(1,30.57) = 0.63$, $p = 0.43$, $\eta^2_g = 0.00$, BF01 = 3.29 ± 0.02% (see **Figure 1C**). Hence, and critical to the present research endeavor, cognitive load impaired EC even when the encoding of individual CS and US stimuli composing a CS-US pair was preserved.

This reduction of EC to non-significance in the depletion condition could be due to a weak statistical power. Indeed, only 30 CS-US pairs in the depletion condition for which both the CS and US stimuli were correctly retrieved were available. The number of available data points, however, allows the detection of an effect size as small as $\eta^2_g = 0.05$ with a statistical power of $(1-\beta) = 0.80$ given the one-sided test (i.e., positive CSs are preferred to negative CSs) and a type I error probability of $\alpha = 0.05$. As a matter of fact, the present study had 99% power for detecting an EC effect size of a magnitude similar to the one observed in the control condition (i.e., $\eta^2_g = 0.44$). Furthermore, the Bayesian analysis suggests 'substantial evidence in favor of the null-hypothesis', which adds to the proposal that the non-significant EC under the depletion condition is not due to data insensitivity (Wagenmakers et al., 2011).

Memory and EC

In a further—exploratory and non-preregistered—analysis, we examined CS evaluative ratings as a function of US valence and Pair types. Thus, we were able to test what type of memory (i.e., memory of individual CS, of individual US, and of their pairing) is *necessary* for EC. We first categorized each CS-US pair along five categories: zero-memory (neither the CS nor the US was correctly retrieved), CS-only memory pairs (the CS but not the US was retrieved), US-only memory (the US but not the CS was retrieved), CS-and-US memory (both CS and US were retrieved, but their pairing was not), and CS-US pairing memory (the CS, the US, and their pairing were correctly retrieved).

CSs evaluative ratings were then submitted to a 2 (US valence: positive, negative) × 5 (Pair: zero-memory, CS-memory, US-memory, CS-and-US memory, CS-US pairing memory) full repeated measures ANOVA (see **Figure 2**). A US valence × Pair interaction was observed, $F(4,240.54) = 7.30$, $p < 0.001$, $\eta^2_g = 0.09$, BF10 > 1000. Looking at the simple effects of US valence by Pair types, a US valence effect (i.e., an EC effect) was observed for the CS-US pairing memory pairs, $t(92.99) = 6.58$, $p < 0.001$, BF10 > 1000, but not for the CS-and-US memory pairs, $t(93.55) = 0.45$, $p = 0.66$, BF01 = 4.31 ± 0.03%, the US-memory pairs, $t(61.73) = 0.94$, $p = 0.34$, BF01 = 2.69 ± 0.01%, the CS-memory pairs, $t(24.56) = 0.75$, $p = 0.46$, BF01 = 2.26 ± 0.01%, and the zero-memory pairs, $t(12.86) = 0.91$, $p = 0.38$, BF01 = 1.95 ± 0.01%. In sum, EC was observed only when both individual stimuli and their pairing were correctly retrieved.

The mediating role of pairing memory between load and EC

In a final—exploratory and non-preregistered—analysis, we examined memory for CS-US pairings and for individual CSs and USs as potential mediators of the causal Load-to-EC relation. We first computed a baseline-corrected EC score by participant [(CSpositive – CSneutral) – (CSnegative – CSneutral)], with higher score indicating higher EC. We then regressed this score in three steps (see **Table 1**). In the first step, we observed EC was predicted by the load manipulation (coded 'control' = 0.5, 'depletion' = –0.5; $b = 2.02$, 95% CI [1.15, 2.88], $t(79) = 4.63$, $p < 0.001$, BF10 > 1000). In the second step, we added individual stimuli memory performance to the model. This factor did not predict EC (b = 0.14, 95% CI [–3.15, 3.43], $t(78) = 0.09$, $p = 0.93$, BF01 = 2.59 ± 0.76%), nor did it reduce the

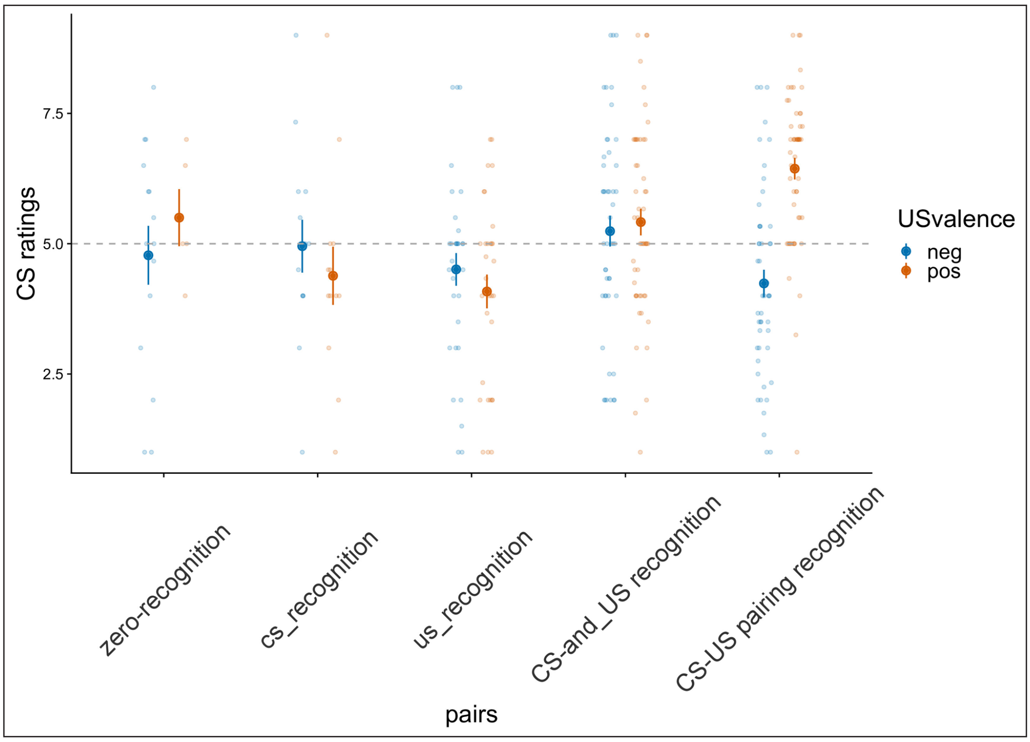

Figure 2: CS ratings as a function of Pair type. Individual data points are represented with dots and are summarized through their observed means, as well as their standard errors around the means.

Table 1: Regression results using EC as the criterion.

Predictor	b	b 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	Fit	Difference
Intercept	0.88**	[0.44, 1.31]				
Load	2.02**	[1.15, 2.88]	0.21	[0.07, 0.36]		
					$R^2 = 0.214$**	
					95% CI[0.07, 0.36]	
Intercept	0.77	[–1.80, 3.33]				
Load	1.96*	[0.48, 3.45]	0.07	[–0.03, 0.17]		
Individual memory	0.14	[–3.15, 3.43]	0.00	[–0.00, 0.00]		
					$R^2 = 0.214$**	$\Delta R^2 = 0.000$
					95% CI[0.06, 0.35]	95% CI[–0.00, 0.00]
Intercept	0.61	[–1.82, 3.04]				
Load	0.51	[–1.18, 2.20]	0.00	[–0.02, 0.02]		
Individual memory	–1.36	[–4.62, 1.91]	0.01	[–0.02, 0.03]		
Pairing memory	3.08**	[1.12, 5.05]	0.09	[–0.02, 0.19]		
					$R^2 = 0.302$**	$\Delta R^2 = 0.088$**
					95% CI[0.12, 0.43]	95% CI[–0.02, 0.19]

Note: A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. sr^2 represents the semi-partial correlation squared. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.
* indicates $p < 0.05$. ** indicates $p < 0.01$.

impact of the load on EC (see **Table 1**). In the third step, we added CS-US pairing memory in the model. Whereas CS-US pairing memory strongly predicted EC (b = 3.08, 95% CI [1.12, 5.05], $t(77) = 3.12$, $p = 0.003$, BF10 = 23.39 ± 1.11%), the load factor was no more related to EC (b = 0.51, 95% CI [–1.18, 2.20], $t(77) = 0.60$, $p = 0.60$, BF01 = 1.50 ± 0.81%, for the full reporting, see **Table 1**). We conclude that cognitive load reduces EC to non-significance because it hampers the encoding of CS-US pairings.

Discussion

Previous studies suggest load disrupts EC by hampering the encoding of CS-US pairing, making it a non-efficient attitude formation effect (Dedonder et al., 2010; Mierop et al., 2017; Pleyers et al., 2009). It was correctly pointed out, however, the inability to encode individual components of CS-US pairings under load, rather than the inability to encode their pairing, may have been responsible for the effect of load on the EC effect and CS-US pairing memory. Here, we observed the auditory two-back task reduced memory for individual CS and US stimuli, as well as for their pairing. However, we also found load reduces EC to non-significance even when individual stimuli entering a pairing are successfully retrieved. We more generally found EC is observed only when there is a successful retrieval of CS-US pairings. This finding, along with the mediation results obtained here, is fully consistent with previous research supporting the critical role of attention paid to CS-US pairings at encoding for establishing EC effects (e.g., Kattner, 2012; Stahl et al., 2016). In contrast, the present findings go against previous research concluding the correct encoding of individual stimuli may be sufficient for EC to occur (Halbeisen & Walther, 2015).

By relating EC effects to a Load manipulation and to memory measures for both CS-US pairings and individual CSs and USs, the present research constitutes the first empirical indication EC is non-efficient because it relies on a non-efficient encoding of CS-US relations. This, in turn, is consistent with a broader range of findings that question the automaticity of attitude formation (see Corneille & Stahl, 2019). Because dual-learning of attitude theories explicitly state the efficiency of associative attitude learning (e.g., Gawronski & Bodenhausen, 2014), the present findings challenge this theorization. Recently, however, attitude learning researchers have noted operating conditions may be agnostic to whether learning effects are driven by propositional or associative processes (De Houwer, 2018; Gawronski & Bodenhausen, 2018).

An important assumption we made is memory measures are valid indicators of encoding effects. Memory measures capture encoding, but also consolidation and retrieval effects. This may be a problem when looking at simple correlations between memory and EC measures (Gawronski & Walther, 2012; Sweldens, Corneille & Yzerbyt, 2014). However, the memory measures were not collected here in an experimental vacuum. They were examined as a function of a Load manipulation implemented during exposure to CS-US pairs. Because past research has demonstrated the immediate effect of a two-back task on encoding capacities (e.g., Jonides et al., 1997; Kane & Engle, 2002), we can confidently assume the memory measures we used here reliably captured a

Load effect on encoding, one that was evidenced later at retrieval. As a matter of fact, the combined use of an experimental manipulation and memory measure has been specifically recommended for a validation of these measures as indicators of encoding effects (see Sweldens, Corneille & Yzerbyt, 2014). More generally, however, the present findings are fully consistent with a retrieval-based approach to evaluations, which states memory contents retrieved at the evaluation stage, which vary as a function of what information is encoded, underlie evaluations (Gast, 2018; Stahl & Aust, 2018).

One could argue the memory measures we used could be sensitive to affect-as-information heuristic, which may lead to memory estimates inflation. That is, when the valence of a US paired with a given CS cannot be retrieved, participants may rely on the valence conditionally acquired by the CS to infer US valence. In recent research, Hütter, Sweldens, Stahl, Unkelbach, and Klauer, (2012) argued *valence* memory performance may be contaminated by an affect-as-information heuristic. By relying on US *identity* measures, however, we strongly reduced an artefactually inflated pairing memory. It should also be noted, even assuming such problem may have to some extent arose, there is no reason to postulate it would have differentially influenced low and high load conditions. Finally, because identity measures are more conservative than valence identity measures (Stahl, Unkelbach & Corneille, 2009), our current choice was facilitating EC in the (presumed) absence of successful CS-US encoding. That is, CS-US pairs we considered unsuccessfully encoded (based on US identity measures) could actually have been successfully encoded (based on US valence measures). The current findings are consistent with previous research stressing the importance of processing the CS-US *relation* in EC effects (Corneille et al., 2009; Kattner, 2012; Mierop et al., 2019; Stahl et al. 2016) and suggest this processing is non-efficient. Future research may identify conditions under which attitude formation is efficient. It cannot be excluded efficient EC might be found when using other evaluative measures, sensory modalities, pairing procedures, or types of stimuli. To date, however, the detrimental impact of load on EC has been observed using indirect evaluative measures (Davies et al., 2012), conditioning paradigms presumably conducive to implicit misattribution (Mierop et al., 2017), unfamiliar CSs (Dedonder et al., 2010), and CS from both visual and gustatory modalities (Davies et al., 2012).

Notes

[1] Priors and methods of computation are the defaults provided in Rouder, Morey, Speckman, and Province (2012). For the models reported here, the r scale values were set to ½, which corresponds to "medium" priors.

[2] Due to the uneven proportions of observations across the different type of pairs, we report the F tests and degrees of freedom based on Kenward-Roger approximation. This analytical strategy was also used for the next and last statistical model.

Additional File

The additional file for this article can be found as follows:

- **Data Accessibility Statement.** All materials (databases, scripts, measures, manipulations, and online appendix) are publicly available at. DOI: https://doi.org/10.5334/irsp.339.s1

Competing Interests

The authors have no competing interests to declare.

References

Blask, K., Walther, E., Halbeisen, G., & **Weil, R.** (2012). At the crossroads: Attention, contingency awareness, and evaluative conditioning. *Learning and Motivation*, *43*(3), 99–106. DOI: https://doi.org/10.1016/j.lmot.2012.03.004

Champely, A. S., Ekstrom, C., Dalgaard, P., Gill, J., Wunder, J., & **De Rosario, H.** (2013). *Package "pwr"*.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences. 2nd*. Hillsdale, NJ: Erlbaum.

Corneille, O., & **Stahl, C.** (2019). Associative Attitude Learning: A Closer Look at Evidence and How It Relates to Attitude Models. *Personality and Social Psychology Review*, 1088868318763261. DOI: https://doi.org/10.1177/1088868318763261

Corneille, O., Yzerbyt, V. Y., Pleyers, G., & **Mussweiler, T.** (2009). Beyond awareness and resources: Evaluative conditioning may be sensitive to processing goals. *Journal of Experimental Social Psychology*, *45*(1), 279–282. DOI: https://doi.org/10.1016/j.jesp.2008.08.020

Davies, S. R., El-Deredy, W., Zandstra, E. H., & **Blanchette, I.** (2012). Evidence for the role of cognitive resources in flavour–flavour evaluative conditioning. *Quarterly Journal of Experimental Psychology*, *65*(12), 2297–2308. DOI: https://doi.org/10.1080/17470218.2012.701311

Dedonder, J., Corneille, O., Yzerbyt, V., & **Kuppens, T.** (2010). Evaluative conditioning of high-novelty stimuli does not seem to be based on an automatic form of associative learning. *Journal of Experimental Social Psychology*, *46*(6), 1118–1121. DOI: https://doi.org/10.1016/j.jesp.2010.06.004

De Houwer, J. (2018). Propositional models of evaluative conditioning. *Social Psychological Bulletin*, *13*(2). DOI: https://doi.org/10.5964/spb.v13i3.28046

Gast, A. (2018). A Declarative Memory Model of Evaluative Conditioning. *Social Psychological Bulletin*, *13*(3). DOI: https://doi.org/10.5964/spb.v13i3.28590

Gast, A., & **Rothermund, K.** (2011). What you see is what will change: Evaluative conditioning effects depend on a focus on valence. *Cognition and Emotion*, *25*(1), 89–110. DOI: https://doi.org/10.1080/02699931003696380

Gawronski, B., & **Bodenhausen, G. V.** (2014). The associative-propositional evaluation model: Operating principles and operating conditions of evaluation. In *Dual-process theories of the social mind* (pp. 188–203).

Gawronski, B., & **Bodenhausen, G. V.** (2018). Evaluative Conditioning from the Perspective of the Associative-Propositional Evaluation Model. *Social Psychological Bulletin*, *13*, Article e28024. DOI: https://doi.org/10.5964/spb.v13i3.28024

Gawronski, B., & **Walther, E.** (2012). What do memory data tell us about the role of contingency awareness in evaluative conditioning? *Journal of Experimental Social Psychology*, *48*(3), 617–623. DOI: https://doi.org/10.1016/j.jesp.2012.01.002

Halbeisen, G., & **Walther, E.** (2015). Dual-task interference in evaluative conditioning: Similarity matters! *Quarterly Journal of Experimental Psychology*, *68*(10), 2008–2021. DOI: https://doi.org/10.1080/17470218.2014.1002506

Hütter, M., Sweldens, S., Stahl, C., Unkelbach, C., & **Klauer, K. C.** (2012). Dissociating contingency awareness and conditioned attitudes: Evidence of contingency-unaware evaluative conditioning. *Journal of Experimental Psychology: General*, *141*(3), 539–557. DOI: https://doi.org/10.1037/a0026477

Kattner, F. (2012). Revisiting the relation between contingency awareness and attention: Evaluative conditioning relies on a contingency focus. *Cognition & Emotion*, *26*(1), 166–175. DOI: https://doi.org/10.1080/02699931.2011.565036

Lang, P. J., Bradley, M. M., & **Cuthbert, B. N.** (1997). International affective picture system (IAPS): Technical manual and affective ratings. *NIMH Center for the Study of Emotion and Attention*, 39–58.

Lawrence, M. A. (2016). *Package 'ez'*.

Melnikoff, D. E., & **Bargh, J. A.** (2018). The Mythical Number Two. *Trends in Cognitive Sciences*, *22*(4), 280–293. DOI: https://doi.org/10.1016/j.tics.2018.02.001

Mierop, A., Bret, A., Yzerbyt, V., Dumas, R., & **Corneille, O.** (2019). Evaluative influences of CS-US pairings are non-reciprocal. *Social Psychological Bulletin*, *14*(1). DOI: https://doi.org/10.32872/spb.v14i1.31408

Mierop, A., Hütter, M., & **Corneille, O.** (2017). Resource Availability and Explicit Memory Largely Determine Evaluative Conditioning Effects in a Paradigm Claimed to be Conducive to Implicit Attitude Acquisition. *Social Psychological and Personality Science*, *8*(7), 758–767. DOI: https://doi.org/10.1177/1948550616687093

Moors, A., & **De Houwer, J.** (2006). Automaticity: A Theoretical and Conceptual Analysis. *Psychological Bulletin*, *132*(2), 297–326. DOI: https://doi.org/10.1037/0033-2909.132.2.297

Morey, R. D., Rouder, J. N., & **Jamil, T.** (2015). BayesFactor: Computation of Bayes factors for common designs. *R package version 0.9*, *9*, 2014.

Pleyers, G., Corneille, O., Yzerbyt, V., & **Luminet, O.** (2009). Evaluative conditioning may incur attentional costs. *Journal of Experimental Psychology: Animal Behavior Processes*, *35*(2), 279–285. DOI: https://doi.org/10.1037/a0013429

R Development Core Team. (2017). *A language and environment for statistical computing*. Consulté à l'adresse http://www.R-project.org

Rouder, J. N., Morey, R. D., Speckman, P. L., & **Province, J. M.** (2012). Default Bayes factors for ANOVA designs. *Journal of Mathematical Psychology*, *56*(5), 356–374. DOI: https://doi.org/10.1016/j.jmp.2012.08.001

Stahl, C., & **Aust, F.** (2018). Evaluative Conditioning as Memory-Based Judgment. *Social Psychological Bulletin*, *13*(3). DOI: https://doi.org/10.5964/spb.v13i3.28589

Stahl, C., Haaf, J., & **Corneille, O.** (2016). Subliminal evaluative conditioning? Above-chance CS identification may be necessary and insufficient for attitude learning. *Journal of Experimental Psychology: General*, *145*(9), 1107–1131. DOI: https://doi.org/10.1037/xge0000191

Stahl, C., Unkelbach, C., & **Corneille, O.** (2009). On the respective contributions of awareness of unconditioned stimulus valence and unconditioned stimulus identity in attitude formation through evaluative conditioning. *Journal of Personality and Social Psychology*, *97*(3), 404–420. DOI: https://doi.org/10.1037/a0016196

Sweldens, S., Corneille, O., & **Yzerbyt, V.** (2014). The Role of Awareness in Attitude Formation Through Evaluative Conditioning. *Personality and Social Psychology Review*, *18*(2), 187–209. DOI: https://doi.org/10.1177/1088868314527832

Verwijmeren, T., Karremans, J. C., Stroebe, W., & **Wigboldus, D. H. J.** (2012). Goal relevance moderates evaluative conditioning effects. *Learning and Motivation*, *43*(3), 107–115. DOI: https://doi.org/10.1016/j.lmot.2012.06.002

Wagenmakers, E.-J., Wetzels, R., Borsboom, D., & **Van Der Maas, H. L.** (2011). Why psychologists must change the way they analyze their data: The case of psi: Comment on Bem (2011). *Journal of Personality and Social Psychology*, *100*(3), 426–432. DOI: https://doi.org/10.1037/a0022790

How to cite this article: Mierop, A., Maurage, P., & Corneille, O. (2020). Cognitive Load Impairs Evaluative Conditioning, Even When Individual CS and US Stimuli are Successfully Encoded. *International Review of Social Psychology*, 33(1): 3, 1–7. DOI: https://doi.org/10.5334/irsp.339

Submitted: 13 August 2019 **Accepted**: 17 January 2020 **Published:** 21 February 2020

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