Swedes do ANOVAs and t-tests only

Participants in Swedish studies all lived immersed, in ES in L1 communities

L1 Swedes and some INT may have been too old

Nouns and verbs mixed

L1 varies

Sometimes even L3s and L4s present

Proficiencies in L2 Swedish self-reported most of the time

In Swedish, no advanced groups

INT do not always predict as or better than normal L2ers

**Schremm et al., 2016**

Goal: whether adult L2 learners of Swedish acquire the native-like ability to activate tone-suffix associations during speech processing, without having received any explicit instruction or information about the underlying L2 regularity.

Pop: non-tonal L1-L2 SW (intermediate to upper-intermediate based on course taken at the moment). All participants had L3 (EN or ES), and some L4 to some degree (1 low to intermediate proficiency in Chinese). Lived immersed; Mean age 25.4 years, SD = 5.32. L1 SW control group (mean age of 37.1 years (SD = 14.53))

Stim: verbs (present and past)

Meth: RT

Results: NSs had longer overall RTs than L2 learners. In both groups, invalidly cued suffixes took longer to process than correctly cued suffixes, although difference smaller in L2. In L1 shorter response latencies to present tense relative to past tense suffixes. L2 similar RTs for present tense and past tense suffixes.

Finding: the present response time experiment suggest that L2 learners at an intermediate proficiency level do in fact unconsciously use word accents as predictive cues to upcoming grammatical suffixes in a way similar to NSs, albeit less extensively. L2 learners nevertheless displayed a relatively smaller processing advantage for target verbs with validly cued suffixes. For participants in the present study, the use of tone variation as a predictive cue to grammatical suffixes is a feature that is specific to the L2 language being acquired, i.e. Swedish; therefore, transfer of L1 speech comprehension strategies cannot account for the near native-like word accent processing patterns observed in the L2 group investigated. Apparently, learners implicitly acquired the underlying regularity, possibly through domain-general statistical learning mechanisms absorbing transitional probabilities between adjacent stem tones and suffixes.

In conclusion, results of the present study suggest that relatively proficient L2 learners of Swedish process word accents in a manner similar to NSs, by unconsciously anticipating upcoming suffixes based on the tonal pattern of the word stem. Smaller processing difficulties associated with invalidly cued suffixes in the L2 group indicate that learners relied on stem tones less extensively than NSs. Nevertheless, the predictive use of word accents appeared to increase with longer exposure time to the L2 in an immersion context, and learners also showed a tendency to become more native-like in their responses to different tense inflections with increasing scores on the same measure of L2 experience. Thus, through exposure to Swedish and in the absence of explicit instruction, learners seem to have acquired a language feature specific to the L2, i.e. an internalized connection between word accents and grammatical inflections, which can be activated as a predictive device in speech processing.

Transfer: NO (they only talk about transfer in the discussion, no transfer framework provided)

**Schremm et al., 2017**

Goal: determining whether L2 learners showed improvements in carrying out the task constituting the essence of the game after a two-week-period of play, as reflected in their speed and accuracy of performance. Furthermore, the study tested whether such perceptual training would lead to gains even in L2 speech production, manifested in more native-like production of the language feature constituting the predictive cue.

Pop: Non-tonal L1-L2 SW (self-reported proficiency A1-B2), lived immersed

Stim: Verbs in training, verbs and nouns in test

Meth: Game + production

Results: accuracy increased throughout the levels of the game. less time spent in Sweden was associated with greater relative RT decrease. Pairwise comparisons of RT values at each level showed a significant RT reduction from the initial two to the final ten rounds. Accent 1 was generally associated with higher production accuracy relative to accent 2 in both pre- and post- tests. There were no interactions involving the factor Game-presence either, suggesting that training-effects transferred even to novel words not included in the game material.

Finding: Results of the experiment indicate that the prototype effectively promoted the learning of the trained language feature. Furthermore, perceptual training with the prototype seems to have led to increased accuracy even in the production of the L2 tonal cue. the obtained results indicate that playing the prototype effectively promoted the acquisition of the trained tone-suffix co-variations as well as processing the anticipatory function of tones.

Transfer: NO

**Gosselke Berthelsen et al., 2018**

Goal: whether beginner learners of a language can implicitly learn and make use of predictive prosodic cues that do not exist in their native language in order to facilitate the processing of upcoming morphological information

Pop: L1 DE-L2 SW (beginners self-rated: pre-beginners to early intermediate), lived immersed

Stim: noun number (pitch accent), real words

Meth: EEG (sentence boundary task)

Result: Neurophysiological results showed that the native speakers produced the prototypical ERP effects associated with the predictive linguistic processing of word accents: PrAN for word accent- morphology connection followed by a negativity as well as a late positivity for word accent-suffix mismatch. The beginner L2 learner group did not exhibit similar effects. Instead, they produced a negativity which seemed to be driven purely by the non-linguistic tone height difference in the word stem tones and which expanded to right-lateral electrodes with increasing level of proficiency.

Finding: these results indicate rather clearly that the beginner learner group has not yet reached the final, necessary stage in the acquisition of word accents: the word accent-morphology connection. This prevents them from being able to pre-activate suffixes at early stages in the learning process. the present study's results indicate that it takes a relatively high proficiency before learners can reliably predict upcoming information based on available context. This is the case even with a feature that is seemingly optimal for second language learner prediction as it is highly frequent and invulnerable to L1 information processing strategies.

Transfer: NO

**Sagarra & Casillas, 2018**

Goal: investigating the role of proficiency and WM in how monolinguals and adult beginning and advanced learners integrate verb stem lexical stress cues to predict present-past suffixes

Pop: L1 EN-L1 ES (not immersed, standardized prof: beginning (?) and advanced)

Stim: lexical stress-verbs

Meth: VWP

Result: The analysis revealed that only the native speakers fixated on the target words above chance at the offset of the target syllable.

While beginners were sensitive to stress, they did not fixate on targets until after verb suffixes, suggesting that prosodic information used differently in the L1 is not used in early stages of learning for anticipatory purposes.

the advanced learners only anticipated word morphology if the target word’s first syllable had a CVC structure providing extra acoustic information (in this case a nasal coda).

Finding: the combination of the heavy syllable (?) and the acoustic cues of stress in these words may have provided the listener with sufficient acoustic information, which appears to be necessary in an online task such as eye-tracking. In addition to informing lexical access models by showing that adults can integrate L2 suprasegmental cues used differently in the L1 for lexical anticipation, the findings of our second research question shed light on current top-down models of L2 processing that relate late learners’ persistent difficulty acquiring inflectional morphology to problems integrating grammatical information during real-time processing.

Transfer: NO

**Hed et al., 2019**

Goal: measured for the first time the effects that training has on the neural correlates of pre-activation during second language acquisition (SLA) of the tone-suffix association

Pop: L1 varies-L2 SW (prof self-reported, beginner-intermediate)

Stim: noun number/ verb tense (I understood test only with nouns, training with nouns and verbs)

Meth: EEG (RT)

Result: Before training, the PrAN for accent 1 as compared to accent 2 correlated with previous exposure to Swedish. This suggests that the participants had implicitly learned to use the tones as predictors to different degrees, even before training the association, by hearing Swedish being spoken in everyday life. The effect of training on PrAN was evident in the present study, since the individual effect correlated with accuracy during the last ten rounds of playing, but not with accuracy during the first ten rounds. In other words, the participants that had developed a larger pre- activation effect in the event-related potentials also performed better in the tone- suffix association task during the last stages of the game. In the suffix onset ERPs, both similarities and dissimilarities as compared to L1 speakers were found. A left anterior negativity (LAN) effect was observed for invalid tone-suffix stimuli at 225–300 ms post-suffix onset post-training. This could indicate that the participants learned the relation between stem tone and suffix. Interestingly, the LAN was weaker the more accurate participants had answered during the last 10 rounds of playing the training game. Hence, the LAN might capture an intermediate stage of learning where the morphological tone-suffix rule has been acquired and invalid tone-suffix combinations are perceived as a morphological violation. However, as learning becomes more consolidated, the tones might become more integrated into the word representations.

In the present study, the formation of a LAN would seem to indicate that the participants reached a high proficiency level in using the tone-suffix association to pre-activate the upcoming suffix, and the morphological processing load increased when a suffix had been invalidly cued by the wrong tone. However, contrary to previous high-proficiency results, no P600 was found for invalidity post-training. This also contrasts with what has commonly been observed for tone-suffix mismatch in L1 speakers. participants’ overall response times were observed to decrease between pre- and post-training. However, they did not show L1-like responses after the training period. The two weeks of training for the low to intermediate L2 learners in the present study appears not to be sufficient to acquire the same kind of behavioral results as in Schremm et al. (2016).

Comparing ERPs and behavioral data, the ERP data showed signs of prediction, but the behavioral data did not

Finding: Our results seem to imply that the participants pre-activated suffixes to some degree, with accent 1 as a stronger predictor; they reacted to the invalid condition, but still relied more on the suffix when performing the singular/plural judgment task, and thereby did not reprocess the ungrammaticality caused by tone-suffix mismatch.

Transfer: NO

**Lozano-Argüelles et al., 2019**

Goal: whether native speakers and advanced learners use suprasegmental and segmental information to predict a word’s suffix, and whether anticipatory experience affects L2 predictions.

Pop: L1 ES, L1 EN-ES (interpreters and not), do not live immersed

Stim: verbs

Meth: VWP

Results: Past anticipated earlier, CVC antipated better. L2 and INT did not anticipate CV present.

the learners have nearly identical trajectories for CV paroxytones (LAva). In all other conditions, interpreter have steeper slopes with more bowed vertices, indicating later target fixations with regard to non-interpreters. That said, in all conditions the interpreters group fixated on targets in equal proportion to non- interpreters at the offset of the target syllable (the dotted vertical lines), suggesting interpreters fixate on targets later but at a faster rate in some conditions.

Finding: These findings demonstrate that native and non-native spoken word recognition is modulated by suprasegmental and segmental information, revealing that structural integration and lexical recognition go hand in hand. Additionally, phonological sequences associated with fewer possible endings facilitate prediction, and, anticipatory experience, rather than L2 proficiency alone, enhances L2 prediction. These findings indicate that less frequent suprasegmental and segmental information and anticipatory experience facilitate native and non-native spoken word prediction.

Transfer: NO

**Gosselke Berthelsen et al., 2020**

Goal: whether rapid functional changes also materialise in learners’ brains during the acquisition of grammatical tone.

Pop: L1 DE-L2 SW (beginners self-rated); L1 SW

Stim: Noun number and gender, pseudowords (there is no control group then), pitch accent

Meth: EEG

Results: speakers with a tonal background could make use of early, automatic neural processing to assess the novel words and were significantly faster to show differences in later processing as well. Speakers with a non-tonal background relied mainly on late processing components to access the meaning of the novel words. Interestingly, despite the obviously different processes involved in the acquisition, there were no between-group differences in the behavioural performance (Non-Tonal L1s were indistinguishable from Tonal L1s in the P600 response).

Finding: we believe that non-tonal L2 learners use their general pitch perception abilities to compensate for the lack of L1 word- level pitch processing systems that the tonal L1 learners can fall back on. We suggest that the processing differences we found between Tonal L1s and Non-Tonal L1s are reflective of different types of processing (possibly due to differences in proficiency that remained undetected by the behavioural response) and emerge as a consequence of positive L1- L2 transfer of tone-morphosyntax pattern recognition processes in one group and a lack thereof in the other. This is to say that the Tonal L1s not only had experience with morphosyntactically meaningful tones but also with combinatorial processes involving such tones [which reflected in ERP activity]. Said experience is likely reflected in specified neural networks, which we believe could have given our Tonal L1 learners a considerable advantage in the acquisition of the novel tonal words.

Transfer: YES (what theory?)