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Examining methodological influences on the rhythmic priming effect: A commentary on Kim, McLaren, and Lee (2024)

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The rhythmic priming effect (RPE) refers to improved language performance (typically grammaticality judgements) following regular rhythmic primes compared to various control conditions. This effect has been observed primarily in French, but also in English and Hungarian. However, a recent implementation by Kim, McLaren & Lee (2024), aiming to replicate the RPE in English (Chern, Tillmann, Vaughan & Gordon, 2018), was not successful, inviting a discussion about the conditions under which the RPE could be observed. We here discuss features of Kim et al.'s (2024) implementation that might have reduced the probability of observing the RPE. Compared to Chern et al. (2018), and numerous other studies reporting the RPE, additional delays after the primes and before each sentence were introduced by Kim et al. (2024). This change might have limited beneficial prime effects, which persist, but decay over time. Further, their instruction to "relax and have some rest" might have reduced attentive processing of the primes and related entrainment. Finally, their sample was small (n =16 per experiment) and with a large age range for investigating typically developing children (7-12y), potentially reducing experimental effects due to development-related individual variations. These methodological changes and sample characteristics are discussed in relation to previous research on the RPE, and

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entrainment in general. This discussion prompts the need for future research to investigate conditions leading to the RPE, with the aim to shed light on underlying mechanisms. Better understanding the RPE will be critical for the use of rhythmic priming within clinical and educational settings.

Introduction

Music and speech/language processing share cognitive and neural resources, particularly in relation to rhythm processing (e.g., Fiveash et al., 2021). Correlational studies have revealed associations between music rhythm and speech/language skills (i.e., grammar; Gordon, Shivers, et al., 2015; Lee et al., 2020), and experimental studies have shown benefits of rhythmic priming and training on speech/language processing in both long-term and short-term implementations (Flaugnacco et al., 2015; Przybylski et al., 2013). Such research has attracted interest with the potential for developing rhythmic training programs for children with language difficulties (e.g., Fiveash et al., 2021; Ladányi et al., 2020). One paradigm to boost short-term performance is rhythmic priming, whereby musical primes with regular rhythms (compared with control conditions) are presented before naturally spoken speech, resulting in enhanced speech processing. The *rhythmic priming effect* (RPE) has been found across several studies in different languages, age groups, and clinical populations (see Table 1).

Kim et al. (2024) aimed to provide further evidence for the RPE on grammaticality judgments in English, previously shown by Chern et al. (2018), and to extend it to a sentence comprehension task. For grammaticality judgments, the authors reported that the RPE was not replicated either with speech material rendered by speech synthesis (Experiment 1) or with speech produced by a native English speaker (Experiment 2, using original recordings of Chern et al., 2018). However, Kim et al. (2024) made several changes to the implementations of Chern et al. (2018) and previous priming studies, which thus does not constitute a direct replication attempt, and may have influenced the null result. Highlighting these changes should shed light on mechanisms underlying the RPE and conditions necessary to observe it. Our commentary aimed to briefly review current evidence for the RPE, outline theoretical and methodological reasons as to why the RPE might not have been observed in Kim et al. (2024), and propose suggestions for future research to better understand the RPE and its potential applications.

The rhythmic priming effect

A growing set of studies have shown that rhythmic priming can benefit processing of a subsequently presented speech signal. Early work investigated short-term benefits of rhythm on language processing in patients with basal ganglia lesions (Kotz et al., 2005): When sentences were preceded by music with regular metric structure, the neural response to grammatical errors (the P600) was observed even though it was previously reported to be missing in this population (Kotz et al., 2003). Subsequent studies showed that regular primes boosted grammaticality judgments in naturally spoken sentences compared with control conditions. Evidence for this RPE was first shown within participants by Przybylski et al. (2013) for French-speaking children with dyslexia, development language disorder (DLD), and chronological-age- and reading-age-matched typically developing (TD) controls. Grammaticality judgments were better after regular primes than after irregular primes, a result replicated in Hungarian-speaking children with DLD and TD children (Ladányi et al., 2021) and English-speaking TD children (Chern et al., 2018). The RPE was also shown on a neural level, with larger P600 responses to grammatical errors after regular rhythmic primes than after irregular rhythmic primes in adults with and without dyslexia (Canette, Fiveash, et al., 2020).

Table 1
Overview of rhythmic priming study characteristics listed in chronological order.

Reference	Prime types	Instructions	Sample size	Age (years; months)	Performance level in syntax-related tasks	Control task performance
Przybylski et al., 2013, Experiment 1 (French)	Reg Irreg (32 s)	“Listen to the music”	n = 32: DLD: n = 12 TD_CA: n = 12 TD_RA: n = 8	DLD: 6;6–12;11 TD_CA: 6;6–11;11 TD_RA: 6;6–8;8	Reg > Irreg, no interaction with group	
Przybylski et al., 2013, Experiment 2 (French)	Reg Irreg (32 s)	“Listen to the music”	n = 28: DYS: n = 10 TD_CA: n = 10 TD_RA: n = 8	DYS: 8;6–10;10 TD_CA: 8;6–10;10 TD_RA: 6;6–8;10	Reg > Irreg, no interaction with group	
Bedoin et al., 2016 (French)	Reg (32 s) Env sounds (30 s)	“Listen to the music”	n = 32: DLD: n = 16 TD_CA: n = 16	DLD: 7;3–10;11 TD_CA: 7;4–11;0	Reg > Irreg, no interaction with group	
Chern et al., 2018 (English)	Reg Irreg (32 s)	“Listen to the music”	TD: n = 16	TD: 5;6–8;7	Reg > Irreg	Visuospatial task: Reg = Irreg Math task: Reg = Irreg
Canette et al., 2019 (French)	Reg Irreg (32 s)	“Listen to the music”	n = 25	Adults: 19–26 years	Reg > Irreg	
Canette, Lalitte, et al., 2020 (French)	Reg Texture Silence Base (17 s)	“Listen to the musical sequences”	Syntax task: n = 16 Semantic task: n = 14 Silence control: n = 16	Syntax: 7;2–8;11 Semantic: 7;6–8;5 Control: 6;10–8;7	Syntax: Reg > Texture Reg > Silence	Semantic (words produced): Texture > Reg
Canette, Fiveash, et al., 2020 (French)	Reg Irreg (32 s)	“Listen to the music”	DYS: n = 13 TD: n = 13	DYS adults: M = 23.2 years TD adults: M = 22.5 years	Reg > Irreg for P600 (EEG study)	
Fiveash, Bedoin, et al., 2020 (French)	Reg Irreg (8 s, 16 s, 32 s)	“Listen carefully”	Experiment 1: n = 32 Experiment 2: n = 35	Experiment 1: 7;5–9;25 Experiment 2: 7;6–9;3	Reg > Irreg for 32 s primes (not 8 s or 16 s)	
Ladányi et al., 2021 (Hungarian)	Reg Irreg Silence Base (32 s)	“Relax and take some rest”	DLD: n = 17 TD_IQ: n = 17	DLD: M = 6;2 TD_IQ: M = 6;2	Reg > Irreg Reg > Silence Irreg = Silence	Picture naming task: Reg = Irreg = Silence Nonverbal Stroop task: No beneficial effect of Reg on accuracy/ RT.

(*continued on next page*)

Table 1 (*continued*)

Reference	Prime types	Instructions	Sample size	Age (years; months)	Performance level in syntax-related tasks	Control task performance
Fiveash et al., 2023 (French)	Reg Irreg (32 s)	"Listen carefully"	DLD: n = 15 TD_CA: n = 18	DLD: M = 9;2 TD_CA: M = 8;8	Sentence repetition: Reg > Irreg	Visuospatial search task: No main effect of group, prime, or interaction
György et al., 2024 (French Jabberwocky sentences)	Reg Irreg Silence (32 s)	Not reported	Experiment 1: n = 41 Experiment 2: n = 51	TD adults	For first three sentences only: Experiment 1: Reg > Irreg Silence > Irreg Reg = Silence Experiment 2: Reg > Irreg Silence = Reg Silence = Irreg	

Note. None of the studies included additional delays before the presentation of the first sentence and after the child's response and the next sentence. All studies used a grammaticality judgment task as in Chern et al. (2018) except Fiveash et al. (2023), who used a sentence repetition task that involved grammatical processing. TD, typically developing children; DLD, children with developmental language disorder (previously labeled SLI [specific language impairment]); DYS, children with dyslexia; TD_CA, chronological age control; TD_RA, reading age control; TD_IQ, IQ-matched control; Reg, regular prime; Irreg, irregular prime; Env sounds, environmental sounds; RT, response time; EEG, electroencephalography.

Follow-up studies ruled out alternative explanations based on processing costs due to *irregular* primes. Language performance was better after regular primes than after control primes, including silence (Ladányi et al., 2021), textural sounds (Canette, Lalitte, et al., 2020), and environmental sounds (Bedoin et al., 2016; see Bedoin et al., 2018, for a first clinical implementation). Other explanations based on processing benefits due to increased *arousal* after regular primes were also ruled out. No benefit of regular primes was found for (a) *non-linguistic control tasks,* including visuospatial search (e.g., Fiveash et al., 2023), math (Chern et al., 2018), and nonverbal Stroop tasks (Ladányi et al., 2021), or for (b) *non-sequential linguistic control tasks,* including picture naming (Ladányi et al., 2021) and semantic evocation (Canette, Lalittle, et al., 2020; Canette et al., 2021). Therefore, benefits of regular primes appear specific to syntax processing in language, perhaps related to the processing of prosodic units and markers of syntactic information (Gordon, Jacobs, et al., 2015). Furthermore, the importance of shared hierarchical structure building processes to the RPE has recently been shown by using Jabberwocky sentences (György et al., 2024).

A primary explanation underlying the RPE is the dynamic attending theory (DAT), suggesting that internal neural oscillations entrain to external rhythmic stimuli, orienting attention over time (Jones, 1976, 2018). Rhythmic primes provide predictable regular cues to enhance entrainment of neural oscillations, which should persist once the rhythm has stopped, benefiting subsequent speech processing. The underlying beat/pulse of the prime and its metrical structure is hypothesized to influence the development of expectations about the temporal occurrence of subsequent events, facilitating processing, sequencing, integration, and syntactic parsing (Kotz & Schwartze, 2010).

Theoretical and methodological considerations of Kim et al. (2024)

Potential influences of delay and attention on the RPE

The DAT applied to the RPE suggests that the effect might (a) decrease over time after the end of the prime, thereby being sensitive to delay between prime and task, and (b) be enhanced when listeners pay attention to the primes. In contrast to Chern et al. (2018) and previous implementations, two features were changed in Kim et al. (2024) that might influence the RPE. First, the *delay* was increased between the prime and the to-be-processed sentences, potentially decreasing the priming effect over time. Second, their instruction to “relax and have some rest” might have *reduced the attentive processing* of the primes.

Effect of delaying the task after the prime

Compared with Chern et al. (2018) and previous rhythmic priming studies, Kim et al. (2024) introduced two additional delays that could be argued to work against the conditions leading to the RPE, namely that (a) the first sentence was presented 3s after the prime in Experiment 1, and 3-3.5s ($\sim$3.25s average delay) in Experiment 2, and (b) an additional 2s was added before each sentence in Experiment 1, and 2-2.5s ($\sim$2.25s average delay) in Experiment 2. These changes delayed the presentation of the last sentence in each six-sentence block by 13 s [3 s after prime + (5 $\times$ 2 s after sentences)] in Experiment 1, and by $\sim$ 14.5 s in Experiment 2 (see Supplementary Fig. 1 in online supplementary material). In the DAT framework, and even when considering context effects decaying over time, these delays should result in a dampened benefit of the preceding prime on sentence processing.

In Chern et al. (2018) and previous rhythmic priming studies (see Table 1), sentences were directly presented after the prime ended (either triggered by the experimenter, followed by a visual cue, or presented immediately) and thus should benefit from persistent entrained oscillations. Although sentence onsets are not directly aligned to the phase of the prime’s underlying beat, the phase reset for the sentence onset should be facilitated by the pre-activation of frequencies shared with the regular prime, enhancing synchronization and entrainment to the speech signal. This hypothesis relates to research showing that endogenous neural oscillations are more easily entrained (needing weaker amplitude of external input) when their period and phase are closer to that of incoming stimuli (e.g., Charalambous & Djebbara, 2023; Zoefel et al., 2018). It is currently not known how long the stimulating effect lasts after the prime has ended. Previous research has provided evidence for the persistence of neural oscillations, even though they diminish in strength over time (e.g., van Bree et al., 2021; Coffey et al., 2021; Lakatos et al., 2013).

Does rhythmic priming require attention?

In Chern et al. (2018) and most rhythmic priming studies (Table 1), participants were asked to listen (attentively) to the music. However, in Kim et al. (2024), children were instructed to "relax and have some rest".[1] Therefore, it cannot be assumed that children were attending to the rhythms, potentially impacting entrainment strength.

Decreased attention to rhythmic primes might have been further exacerbated by two additional features. First, the used primes (originally from Przybylski et al., 2013) were simple in structure and included only one item for each prime type, repeated in an alternating order over the experiment (leading to six presentations of each prime in Kim et al., 2024). Alternating two primes might further reduce interest and attention to the material, particularly when children were not asked to pay attention to the stimuli. Recent studies have introduced more variability, including more complex and musically interesting rhythms to encourage attentive listening (e.g., Canette, Lalitte, et al., 2020).

Second, in Kim et al. (2024), children were tested for 2hrs. This is a long session, even when breaks were allowed between tasks upon request. Before the rhythmic priming tasks, children completed rhythmic and working memory tasks. Combined with the "relax and have some rest" instruction and being tested in a dimly lit room, it becomes less likely that children were attentively listening to the rhythms.[2] Sustained attention ability increases with age, with particularly strong developments in the age range tested here (e.g., 5–12 years; Betts et al., 2006; Lin et al., 1999). This might have introduced extra variance linked to changes in attention span capacity. To limit attentional effects and fatigue, long testing sessions could be broken up into multiple sessions, and/or children could perform the most critical attention-sensitive experiments first.

The potentially reduced attentive processing of the primes due to the paradigm changes in Kim et al. (2024) is important to consider given that the neural response to beat frequencies (Gibbings et al., 2023) and to rhythmic sequence processing (Chapin et al., 2010) is stronger when participants are attentively listening than when they are concurrently completing a visual task. Evidence for persistent oscillations has been reported when participants attended to a stimulus stream (e.g., Lakatos et al., 2013; van Bree et al., 2021), but not when they passively listened and attended to a silent movie (Lerousseau et al., 2021). Finally, under attentive (but not passive) listening conditions, the P3b response to a pitch deviant was larger in regular temporal contexts than in irregular temporal contexts, suggesting that stimulus-driven synchronization might require at least some attention (Schwartze et al., 2011). These findings, combined with the DAT, suggest that attention is a critical element in the strength and persistence of neural oscillations. Although passive listening can entrain the brain to external rhythms, without directed attention, the strength of the driven oscillations is likely reduced (Jones, 2018). Thus, the passive listening setup in Kim et al. (2024) might not have engaged entrainment and beat-based processing resources as strongly as in Chern et al. (2018) or in previous rhythmic priming studies that asked participants to listen (attentively) to the primes.

Sample characteristics

Sample size and age range

In each experiment, Kim et al. (2024) tested 16 children aged 7 to 12 years, which can be considered a large age range for TD children. Recruitment difficulties for children with developmental disor-

[1] Ladányi et al. (2021) also instructed children to "relax and take some rest"; however, they tested children with DLD and TD children, resulting in an RPE observed over the two groups (*N* = 34), without additional delays, and in Hungarian, so it is difficult to compare with Kim et al. (2024).

[2] In addition, primes were presented over loudspeakers (not headphones as in most previous studies; e.g., Fiveash et al., 2020; Przybylski et al., 2013, although not in Chern et al., 2018), potentially further reducing attentive processing of the prime and its underlying beat. For example, Zelechowska et al. (2020) found that participants moved more when listening to music through headphones compared with loudspeakers. Therefore, it is possible that involvement of the motor system, which strengthens beat perception, might have been reduced compared with typical implementations.

ders often result in groups with wider age ranges. However, studies testing TD children generally cover a smaller age range (i.e., 1–2 years up to 3 years) given that this is a heightened period of language development with large individual differences, especially in grammar development. Norming data of a grammar test shows large distributions and changes in grammar skills from 4 to 15 years of age (Bishop, 2003; Kidd et al., 2018). The automation of grammatical use and knowledge also develops during this time, as seen in the development of correct gender marker use in French at 3 to 9 years of age (Seigneuric et al., 2007).

Previous research has aimed to limit this variability by testing TD children within a smaller age range. Although Chern et al. (2018) also tested 16 TD children,[3] these children were 5 years 6 months to 8 years 7 months of age (see also Table 1). Priming studies investigating clinical populations found no group and prime interaction, resulting in larger sample sizes across groups for the RPE (e.g., n = 32–33; see Table 1). Although Kim et al. (2024) pooled their grammaticality judgment data across both experiments (n = 32), they still did not observe the RPE. It is possible that the RPE might be stronger when focusing on an earlier and more restricted age range as in Chern et al. (2018), who reported a medium effect size (d = 0.57). The variability emerging from a small sample combined with large differences in grammar development during this period may have influenced their null findings. Grammar development in childhood is extremely variable due to differences in experience, frequency of use, and perceived co-occurrence of verbal elements in grammar acquisition and automation (Bybee & Hopper, 2001). This result suggests more complex interactions among sample size, age range, and attention that should be further investigated.

Language background

Kim et al. (2024) noted that most rhythmic priming studies are with French participants and material (except for Chern et al., 2018, in English; Ladányi et al., 2021, in Hungarian; and Kotz et al., 2005 in German). Their results suggest that so-called syllable-timed languages (French and Hungarian) might be more sensitive to rhythmic priming than so-called stress-timed languages (English and German). However, the reversed hypothesis would be suggested by data showing that English sentences are easier to entrain to than French sentences for both English and French speakers (Lidji et al., 2011). The rhythm specific to each language and its match to the prime may be important factors to consider, as suggested by Fernández-Merino et al. (2024), who showed stronger effects with rhythmic cues directly matched to the target speech rhythm. Adapting the rhythmic primes to language-specific speech rhythms could be an important step to generalize rhythmic priming research across languages, albeit challenging for naturally spoken speech. Sharing of audio files for comparison of music and speech rhythms would allow for a better understanding of similarities and differences across stimuli used in rhythmic priming research.

Another difference across experiments and languages is the type of grammatical errors used. The errors in the English stimuli were subject–verb or tense agreement, where changes consisted of adding/removing "s" or "ed" (e.g., "the mom toast/toasts," "the men punched/punch"). The French grammatical errors were more varied, including gender, number, and person agreement (e.g., Przybylski et al., 2013); number, person, gender, tense, auxiliary, morphology, position, and past participle (e.g., Fiveash, Bedoin, et al., 2020); and complex grammatical structures (Canette et al., 2019). Limited variability in error types might decrease interest and difficulty, potentially further reducing motivation and attention across the experiment.

Suggestions for future research

Although the RPE is a promising avenue for speech therapy and educational settings, more needs to be known about the phenomenon. The changes applied by Kim et al. (2024) to the rhythmic priming paradigm and their consequences outlined here now motivate new research to investigate strengths and limits of the RPE. Systematically manipulating the various factors discussed and some additional influences outlined below will provide insights into optimal conditions for the RPE.

[3] This was the basis of Kim et al.'s (2024) sample size justification.

Persistence over time and effect of delay in rhythmic priming

New research should investigate how long the rhythmic priming effect lasts and the impact of additional delays in sentence presentation. Chern et al. (2018) reported that the priming effect did not differ between the first and last three sentences of the set of six sentences, suggesting that it held constant over time. For Jabberwocky sentences, the RPE was found only for the first three sentences, suggesting an additional role for semantic structure building (György et al., 2024). To investigate the duration of the RPE, future research could (a) include more sentences following each prime and analyze performance across time and (b) run sub-analyses of the six-sentence packages in existing data to investigate whether performance deteriorates over time.

It would be interesting to investigate whether the additional delays introduced by Kim et al. (2024) might have (a) reduced the *duration* of the RPE across the sentences, with potential effects only on the first few sentences in a block, and/or (b) removed the RPE *in general* by introducing a delay of ~ 3 s after each prime, disrupting the phase reset to the first sentence and not allowing sustained neural oscillations. Future research could test the effect of adding delays in sentence presentation, both directly after the prime and across the sentences, with the hypothesis that the RPE will be stronger with shorter and fewer delays. This investigation could be combined with the suggestion to increase the number of sentences to see how long the RPE could last.

Individual differences and sample characteristics

Individual differences may influence the potential benefits of rhythmic priming on sentence processing (e.g., reading age, rhythmic processing capacities, auditory attention skills; Fiveash et al., 2020; Fiveash et al., 2023; György et al., 2024). Such differences might be more apparent and variable over large age ranges. Potentially relevant individual differences include language, grammar, and reading skills (e.g., Kidd et al., 2018), musical experience and ability, and general cognition and working memory capacity (WMC). Measuring theoretically-driven individual differences will allow for a better understanding of when rhythmic priming is most likely to be successful. Previous work has shown that reading age relates to the RPE (Fiveash et al., 2020; Fiveash et al., 2023). Although Kim et al. (2024) did not measure reading age, which could have been relevant considering the large age range tested, they tested rhythmic abilities and WMC. Considering links among WMC, rhythm, and grammar acquisition (e.g., Gordon, Shivers, et al., 2015; Verhagen & Leseman, 2016), it would have been interesting to have reported these data to account for individual variability and potentially related effects on rhythmic priming. For adults, auditory attention skills correlated with grammaticality judgments after regular but not irregular rhythms (György et al., 2024), a similar pattern to reading age in children (Fiveash et al., 2020; Fiveash et al., 2023). Combined with findings that rhythm perception skills correlated with grammaticality judgments after regular and irregular rhythms (though more strongly after irregular)[4] these individual differences are important to consider in future research.

Future research should consider collecting and reporting individual differences data with the aim to track the developmental trajectory of the RPE and its link to relevant individual differences for children and adults. This investigation will allow for a better understanding of whether certain age ranges and developmental stages in children (e.g., related to grammar development) might benefit more strongly from rhythmic priming as well as its relationships with auditory attention and beat-based rhythm perception abilities. This will require testing participant groups with small age ranges while ensuring comparable task difficulty and testing larger samples to have enough power to uncover influences of individual differences. Kim et al. (2024) reported that the difference between regular and irregular primes did not correlate with chronological age. Plotting results also separately for performance after regular versus irregular rhythmic primes and depending on individual differences (e.g., chronological age and reading age) as well as showing age distributions would allow for a better

[4] It is possible that participants with strong beat-based processing skills are attempting to impose some structure on the irregular rhythms, as also suggested in the observation of some regularity extraction from control (but not dyslexic) adults to the irregular rhythms in Fiveash, Schön, et al. (2020).

understanding of the variance related to such differences and allow the verification of a balanced sample size.

Manipulating attention and testing for potential motor contributions

To further investigate the relevance of attention for the RPE, a between-participant study could include one group listening attentively to the primes and another group listening passively while performing an attention-grabbing task (e.g., visual search task). Electroencephalography recordings could tease apart strength of neural entrainment with and without directed attention (as in Gibbings et al., 2023), as well as individual differences in beat perception, to potentially predict the impact on subsequent sentence processing. Individual differences in speech entrainment abilities could be further investigated with speech/tapping synchronization tasks (e.g., Assaneo et al., 2019; Lidji et al., 2011).

Adding movement when listening to rhythms may prove to be a promising avenue to enhance the RPE via auditory–motor coupling. Adding a motor component (i.e., tapping, moving along) and/or rhythmic training beforehand is beneficial for rhythmic cueing (Cason et al., 2015; Falk & Dalla Bella, 2016) and might also be beneficial for rhythmic priming.[5] Movement/tapping precision should be measured to ensure that participants are "in time" with regular rhythms, and a control movement task would be needed for irregular rhythms or other control conditions.

Conclusion

Our commentary on Kim et al. (2024) outlined several implementation changes from Chern et al. (2018) and previous rhythmic priming studies to suggest that Kim et al. (2024) cannot be considered a direct replication attempt but rather should be considered a conceptual one. These design changes have shed light on methodological features that might be critical for the RPE and will be important in future experiment designs. Motivated by Kim et al. (2024), methodological aspects and suggestions for research have been outlined that will allow for a better understanding of the conditions necessary to elicit the RPE. This discussion, together with future research, will enhance understanding about involved underlying mechanisms and provide hypotheses for other perceptual and cognitive processes that could be boosted by rhythmic regularity.

CRediT authorship contribution statement

Anna Fiveash: Writing – review & editing, Writing – original draft, Conceptualization. **Nathalie Bedoin:** Writing – review & editing. **Barbara Tillmann:** Writing – review & editing, Writing – original draft, Conceptualization.

Data availability

No data was used for the research described in the article.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2024.106111.

[5] Note that just watching a moving point-light figure does not seem sufficient to enhance priming (Fiveash et al., 2022).

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