


Please cite the Published Version

Ainsworth, Steph and Bell, Huw  (2024) Towards an aesthetics of grammar learning: lifting the veil on language. *Frontiers in Education*, 8. 1305532 ISSN 2504-284X

DOI: <https://doi.org/10.3389/feduc.2023.1305532>

Publisher: Frontiers Media SA

Version: Published Version

Downloaded from: <https://e-space.mmu.ac.uk/633921/>

Usage rights:  [Creative Commons: Attribution 4.0](https://creativecommons.org/licenses/by/4.0/)

Additional Information: This is an open access article which originally appeared in *Frontiers in Education*

Data Access Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Enquiries:

If you have questions about this document, contact openresearch@mmu.ac.uk. Please include the URL of the record in e-space. If you believe that your, or a third party's rights have been compromised through this document please see our Take Down policy (available from <https://www.mmu.ac.uk/library/using-the-library/policies-and-guidelines>)



OPEN ACCESS

EDITED BY

Manuela Heinz,
University of Galway, Ireland

REVIEWED BY

Brian Jon Birdsell,
Hirosaki University, Japan
Emilee Moore,
Autonomous University of Barcelona, Spain

*CORRESPONDENCE

Steph Ainsworth
✉ s.ainsworth@mmu.ac.uk

RECEIVED 02 October 2023

ACCEPTED 19 December 2023

PUBLISHED 01 February 2024

CITATION

Ainsworth S and Bell H (2024) Towards an aesthetics of grammar learning: lifting the veil on language.
Front. Educ. 8:1305532.
doi: 10.3389/feduc.2023.1305532

COPYRIGHT

© 2024 Ainsworth and Bell. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Towards an aesthetics of grammar learning: lifting the veil on language

Steph Ainsworth* and Huw Bell

School of Education, Faculty of Health and Education, Manchester Metropolitan University, Manchester, United Kingdom

The last few decades have seen growing interest in the field of disciplinary aesthetics. While the physical sciences and mathematics have attracted significant interest in this area, relatively little attention has been given to the aesthetic potential of learning about the structure of one's own native language. Within this paper, we bring together ideas from evolutionary aesthetics, philosophy, psychology and neuroscience to explore the question of what might characterize an aesthetics of grammar learning. The paper connects our previous empirical findings with theoretical developments across these disciplines. We argue that explicit grammar learning has a particular potential to evoke aesthetic experience due to its role as a mediator between procedural and declarative knowledge. We suggest that by facilitating the transformation from knowhow to knowledge, grammar learning has the potential to generate cognitive consonance, experienced as an aesthetic-epistemic feeling of fittingness. The discussion draws parallels between the characteristics of grammar and the properties of entities more traditionally conceived to be aesthetic (such as art works and performances). In particular, we note that meta-linguistic labels (grammar terms) provide concrete tokens which facilitate virtual models, supporting the transition from 'automatism' to 'conscious reflection'. The paper concludes by exploring the implications for the field of disciplinary aesthetics and for developing pedagogies which maximize the aesthetic potential of grammar.

KEYWORDS

disciplinary aesthetics, aesthetics, grammar, declarative knowledge, procedural knowledge, epistemic emotions, aesthetic-epistemic feelings, cognitive consonance

Introduction

Background: towards an aesthetics of explicit grammar learning

The day I learnt the basics of grammar as an eight year old was a joyous day for me [...] I loved that there was a set structure that underpinned the language we all employed to communicate and to think (McMahon, 2015, p. 156)

Recent years have seen growing interest in the field of disciplinary aesthetics. Loosely, this can be defined as the ways in which aesthetic judgments, feelings and emotions are expressed or experienced in specific curriculum areas. The development of disciplinary aesthetics can be seen as a component of a wider 'affective turn' in education, the growing recognition of the

importance of affect and emotion as central to educational experience (Zembylas, 2021). While the aesthetic elements of physical sciences and mathematics have attracted significant interest, we believe that almost no attention has been given to the aesthetic potential of learning about the structure of one's native¹ language. In this paper we therefore consider this area of learning from a disciplinary aesthetics perspective.

Historically, in a philosophical literature stretching back to the ancient world, aesthetics as a field of investigation has been most closely associated with those areas which are typically held to have a close affiliation with 'beauty'—primarily art, music and drama, and the natural world (e.g., Ulrich, 1983). More recently, aesthetics has been explored across a broader range of disciplinary fields such as education (e.g., Dewey, 1934), psychology (e.g., Jacobsen and Höfel, 2003) and sociology (e.g., Bourdieu, 1984). There has been considerable interest in aesthetic responses to mathematics, which originally considered the aesthetic nature—the 'cold and austere beauty' (Russell, 1919, p. 60)—of mathematics itself. Recent interest has since widened to include the neurobiological explanations for aesthetic reactions in the study of mathematics (e.g., Zeki et al., 2014) and perceptions of beauty in mathematics among both experts (Hayn-Leichsenring et al., 2022) and laypeople (e.g., Johnson and Steinerberger, 2019). Similarly, there is a substantial body of work investigating the relationship between aesthetic responses and science education (for example, Chandrasekhar, 1979; Girod et al., 2003; Jakobson and Wickman, 2008; King et al., 2015; Wickman et al., 2022). Perhaps unsurprisingly, given their close relationship to mathematics, considerable attention has also been paid to aesthetics in chess (e.g., Margulies, 1977), information theory (e.g., Moles, 1973) and computer programming (e.g., Fishwick, 2006).

Where it directly addresses language, aesthetic theory has typically been preoccupied with the forms of or reactions to language: for example, the aesthetic engagement with literary works as a reader (e.g., Stockwell, 2009), or the language of literature in contrast to everyday language, either in general or in the works of 'great writers'. Analyses also exist of the ways in which some languages or language groups use grammar for aesthetic purposes (e.g., Williams, 2019), and of the individual features of 'beauty' in words and/or sounds (e.g., Crystal, 1995). In addition, over the last 40 years there has developed a substantial literature on affect and second language learning: early work (e.g., Horwitz et al., 1986) dealt largely with language learning anxiety, since which the field has developed considerably (Dewaele and Li, 2020, provide an oversight), and there has been some attention paid to emotional responses to teaching (rather than learning) grammar (Watson, 2012).

However, to the best of our knowledge there is no work dealing specifically with the affective or aesthetic implications of developing explicit knowledge of first language grammar, or of metalinguistic learning in general (which could be about first or other languages).

Despite the lack of research specifically about aesthetic responses to learning about grammar, the similarities between grammar and mathematics, together with the convincing evidence that mathematics can induce aesthetic perceptions suggest that an aesthetic-emotional response to learning about grammar is possible, as McMahon's (2015) 'joyous' recollection suggests. It is not necessary to accept Lambek's assertion that 'to check the grammaticality of an English sentence is like finding the proof of a theorem' (Lambek, 1989, p. 271) to see that mathematical activities can indeed be 'quite analogous' to linguistic activities (Lambek, 1989, p. 257).

Within this paper, then, we explore the potential for explicit grammar knowledge to act as an aesthetic object. We suggest that learning about grammar has a particular potential to evoke aesthetic experience due to its role as a mediator between procedural and declarative knowledge. For clarity, in this paper we use the phrases 'learning about grammar' and 'grammar learning' to refer to the conscious development of explicit knowledge about grammar, rather than the implicit, unexamined knowledge which speakers of a language must have in order to merely use grammar. As a simple example, native speakers of English talk about events which happened in the past using a wide range of formal identifiers, including appropriate tenses, aspects and adverbials; but without specialized learning they are normally unable to state clearly if or how 'I went to see her' is different to 'I had gone to see her' or 'I was going to see her'. Developing the conceptual and terminological knowledge to distinguish them is learning about grammar, and grammatical metalanguage is the grammatical terminology which helps us do this.

Empirical motivation for a hypothesis about the aesthetics of grammar learning

Our interest in the aesthetic dimension of learning explicit grammar knowledge arose from our experiences teaching English grammar to student teachers who were preparing to deliver the National Curriculum (DfE, 2013) in primary schools in England. This curriculum contains a significant amount of explicit grammar terminology (e.g., *fronted adverbial*, *prepositional phrase*) which primary school teachers are required to teach to pupils aged 5–11. The inclusion of this terminology represented a fairly radical change to education in England after the decline of formal grammar education in the 1960s (Hudson and Walmsley, 2005), and our research initially explored how student teachers might respond to the challenge of mastering (and then teaching) a range of grammatical terms and related concepts that many of them had never encountered. What was most striking to us during this project was the fact that the students expressed strong emotional reactions when learning about the structure of their native grammar. Crucially, many of these reactions seemed to be of a distinctly aesthetic nature.

While this project has been reported in detail elsewhere (Bell and Ainsworth, 2019; Ainsworth and Bell, 2020; Bell and Ainsworth, 2021), we provide a brief summary below of the students involved in the project and the nature of the grammar sessions that they engaged with. This will help situate the discussion that follows, where we return to some of the data from the project to illustrate our thesis about the aesthetic dimensions of explicit grammar learning. The grammar sessions which we will refer to were offered to student teachers on the BA in Primary Education. They were offered as an

¹ We refer to 'native speakers' throughout this paper, despite the difficulties associated with the term (Cheng et al., 2021), as shorthand for the types of grammar learners typical of those in our classes. The vast majority of these are monolingual inhabitants of the United Kingdom who, like most English students (Hudson and Walmsley, 2005) had not studied the grammar of English at school.

optional extra to the core program, providing an opportunity for the students to develop their subject knowledge in preparation for teaching grammar to primary school children. The data is drawn from group interviews with 29 student teachers who had attended the grammar sessions. The interviews took place at three time points, following three different iterations of the grammar course delivered to three cohorts of students. The maximum number of sessions available to students was 10 (across a 10-week period), although attendance varied due to the optional nature of the course and competing student commitments.

Within this paper, we speculate as to why the kind of learning that students engaged with within these grammar lessons, might lead to strong affective responses like those that we observed. We explore the hypothesis that *explicit grammar learning has the potential to evoke aesthetic-epistemic feelings associated with the transformation of procedural to declarative knowledge*, drawing upon theoretical ideas from a range of disciplines: evolutionary aesthetics, philosophy, psychology and neuroscience.

Before we present our arguments to support this hypothesis, we will briefly clarify some key terminology, namely the terms epistemic emotions, epistemic feelings and aesthetic-epistemic feelings. Epistemic emotions and epistemic feelings, which Olin (2018), p. 1 collectively calls ‘feelings for knowing’, are the terms given to affective states relating to epistemic aims or processes. A key distinction often made between emotions and feelings is that while emotions are physical reactions to the environment (e.g., an increase in heart beat), feelings are a person’s conscious perception of emotions such as a conscious feeling of anxiety (e.g., Damasio, 1999). However, when it comes to epistemic emotions/feelings specifically, these terms are often used interchangeably with different distinctions being made across disciplines (Arango-Muñoz and Michaelian, 2014). For example, while Dietrich et al. (2020) refer to curiosity as an epistemic feeling, Vogl et al. (2019) categorize it as an epistemic emotion. For the purposes of this paper, we will use the term epistemic feeling in preference to emotion to reflect the fact that that our analysis is centered around students’ reports of their (consciously experienced) feelings. The term aesthetic-epistemic feeling refers to affective states that have both an aesthetic and an epistemic character (Todd, 2018). In the discussions that follow we will argue that grammar learning has the potential to evoke such hybrid affective states in the form of a feeling of fittingness.

Towards an aesthetics of grammar learning

We will now embark on an attempt to identify some of the key characteristics of grammar learning which make it a potential source of aesthetic experience. For each of these characteristics we will try to unravel its epistemic and aesthetic dimensions. While grammar learning is often considered to be a rather dry and austere enterprise—what Hinsliff (2017) calls not ‘bringing language to life but dissecting its cold corpse’—we will argue that it has the potential to evoke rich aesthetic experience. Specifically, we will argue that the intertwined epistemic-aesthetic experience of grammar learning has the potential to evoke a particular kind of ‘feeling for knowing’ (Olin, 2018, p. 1).

Analytic approach

In this paper we report a speculative exploration of the aesthetic potential of grammar learning, by bringing our previous data (Ainsworth and Bell, 2020) into conversation with ideas from evolutionary aesthetics, philosophy, psychology and neuroscience. In the discussion that follows, we draw heavily on Consoli’s (2014) paper on evolutionary aesthetics, as we noticed remarkable parallels between the characteristics of aesthetic experience that Consoli identifies in the context of the evolution of early art/performance and the aesthetic characteristics of explicit grammar learning that seemed to be coming through within our data. While Consoli’s ideas predominate in the ensuing points, we also integrate other concepts from a range of disciplines to illuminate our thoughts on the dual epistemic/aesthetic nature of learning about grammar. Table 1 represents an attempt to summarize the ideas that led us to the hypothesis central to this paper. It helps us to tell the story (albeit tentatively) of what might have been ‘going on’ during our grammar sessions. This table resulted from an iterative process of meaning making where we moved back and forth between our data (reported in detail in Ainsworth and Bell, 2020) and the relevant literatures from the disciplines listed above. We searched for ways to ‘plug these texts into one another’ (Jackson and Mazzei, 2013) in a search for clues as to how we might explain and find a language to talk about the strong affective responses which seemed to accompany our students’ experiences of learning about grammar (reported in detail in Ainsworth and Bell, 2020). The connections we noticed across these literatures led us through a process of iterative

TABLE 1 An initial framework for thinking about grammar learning as an aesthetic experience.

Characteristics of grammar learning	Epistemic dimension	Aesthetic dimension
Explicit bringing into consciousness	Shift from procedural to declarative knowledge Cognitive consonance -> feeling of fittingness Resonance between external stimuli and internal, self-related processing	Novelty x familiarity Structure appearing from the shadows Harmony between the external world and the self
Language as an artifact	Abstraction anchored by metalinguistic labels	Materiality of concrete tokens supports aesthetic experience
Conscious monitoring and manipulation of language	Metacognitive tools for reflection and manipulation Knowledge of self	Aesthetic experience supports virtual realities through decoupled/simulative imaginings The self-relevance of aesthetic experience - being ‘touched within’
(Tools for exploring) desired meanings grounded in socially shared understandings	Knowledge of others Declarative knowledge as a collective workspace to be shared	Aesthetic experience as a vehicle for mind-reading Aesthetic experiences as social glue

thematic analysis (Braun and Clarke, 2006) until we settled on Table 1 as an initial framework for thinking about the aesthetics of grammar learning. This framework is not posited as a definitive ‘theory’ of explicit grammar learning, but rather a first attempt to conceptualize what an aesthetics of grammar might look like, by bringing together ideas from across disciplines. In this way it aligns with a relational onto-epistemological stance (Rovelli, 2022), where we are not attempting to describe an objective ‘reality’ that we stand outside of. But rather, we are engaging in a process of meaning-making, that comes from identifying useful patterns, in this case between the different ways in which aesthetic experience is characterized across disciplines and the aesthetic responses that our students described.

An initial framework for thinking about grammar learning as an aesthetic experience

The framework takes as its starting point Myhill’s definition of metalinguistic understanding as:

the explicit bringing into consciousness of language as an artifact, and the conscious monitoring and manipulation of language to create desired meanings grounded in socially shared understandings’ (Myhill, 2012, p. 250).

Within Table 1 and the surrounding commentary we have parsed this definition into four key characteristics of grammar learning, which we will explore in turn, considering both the aesthetic and epistemic dimensions of the type of learning involved. In this way, we provide evidence to support our speculative hypothesis that *explicit grammar learning has the potential to evoke aesthetic-epistemic feelings associated with the transformation of procedural to declarative knowledge.*

i. Explicit bringing into consciousness...

Learning about grammar represents a particular type of learning. Prior to our grammar sessions, the students were able to use language entirely fluently and correctly, but were unaware of how they did it. For example, they were proficient at producing speech which used the typical structures of English clauses (e.g., subject, verb, object) without knowing that they were doing this, much less the names for the structures or elements of clauses. In epistemic terms, this kind of learning is characterized by a shift from procedural (know *how*) knowledge to declarative (know *that*) knowledge (Ryle, 1949). This characteristic of grammar learning distinguishes it from many other academic activities (e.g., learning calculations in mathematics), where pupils are learning completely new facts or skills (such as number bonds to 10 or how to carry out long division), rather than shifting existing tacit knowledge into a more visible form.

One of the reasons why this knowledge transformation might evoke aesthetic experience is that it lies at the nexus of novelty (which generates interest) and familiarity (which generates feelings of pleasingness) (Dokic, 2016). In this way grammar learning is potentially double weighted in aesthetic terms. Novelty is experienced as students acquire a new set of explicit metalinguistic labels—transforming language structures that were previously hidden into ‘glittering linguistic subjects’ (Crystal interviewed by Marques, 2017, p. 1084). The familiarity, on the other hand, comes from the examples

of everyday language used to teach this new knowledge and the related dawning that they ‘knew’ this all along: ‘Oh! Actually, well we do know that. We just did not know, like the correct word to describe it’ (Ainsworth and Bell, 2020, p. 606).

Another way to conceptualize the moments of insight that students experience when they integrate their new declarative knowledge with their existing procedural knowledge is in terms of a ‘feeling of fittingness’. This term is borrowed from Todd’s (2018), p. 212 exploration of aesthetic evaluation in mathematics. Todd uses the term ‘fittingness’ to describe the pleasurable feeling mathematicians can experience when engaging with elegant mathematical proofs. Todd suggests that when the relation between certain properties of a stimulus and certain cognitive processes operating within the mathematician’s mind are consonant with one another, the person experiences the perception of an ‘inevitability of fit’ (Kosso, 2002, p. 39). While for Todd, the stimuli of interest are mathematical proofs, here we suggest that similar feelings of consonance may be experienced when students ‘fit’ the newly learned structure of grammar onto their existing tacit representations and experience a sense of things falling into place.

Todd argues that this phenomenon of ‘cognitive consonance’ arises when the stimuli/processing relation is characterized by *coherence, breadth of scope, simplicity and fluency* (2018, p. 229). Upon reading Todd’s work, we were struck by the fact that the metalinguistic map which students acquire through learning about grammar meets each of his criteria for cognitive consonance:

- Grammar learning provides an overarching explanatory structure that matches students’ everyday language use (*coherence*)
- This structure is able to capture the complexity of language use in all its variety and generativity (*breadth of scope*)
- English grammar is parsimonious and requires knowledge of a relatively small number of building blocks and rules (*simplicity*)
- Grammar knowledge feels familiar and readily forms a new layer of consciousness (*fluency*) due to the tacit knowledge already being place

We therefore speculate that explicit grammar learning evokes a special kind of cognitive consonance, resulting from the mapping of declarative knowledge onto existing procedural knowledge.²

Todd (2018) argues that feelings of fittingness have a hybrid aesthetic-epistemic nature. As well as being associated with an epistemic experience of understanding, cognitive consonance is proposed to evoke an aesthetic experience of harmony/fit. In support of the notion of feelings of fittingness having an aesthetic nature, a neuroscientific study by Vessel et al. (2013) found that intense aesthetic responses may occur ‘when our brains detect a certain “harmony” between the external world and our internal representation of the self’ (p. 7). While Vessel et al.’s study involved participants engaging with artwork, they argue that their findings are likely to be the ‘tip of the iceberg’ suggesting that ‘instances of resonance between external stimuli and our internal representation of the self’

² Note that we would not expect the same type of cognitive consonance when learning L2 grammar as this would not involve mapping declarative knowledge onto existing procedural knowledge.

(p. 7) may occur frequently in a range of contexts. In the case of grammar learning, students are not engaging with mathematical proofs or artworks, but rather are having the structure of their native language revealed to them, generating moments of insight. These moments might be likened to those experienced during Gestalt detection (e.g., the sudden detection of a hidden structure within a ‘Magic Eye’ image). While students have always had access to the underlying structural rules of their native language (indeed, they have been using them to communicate competently for many years), it is only through explicit teaching and/or learning that the rules are revealed.

Research in the field of psychology, has demonstrated the link between such moments of insight and aesthetic experience. For example, [Muth and Carbon \(2013\)](#) showed participants images which contained hidden faces that were barely detectable. They found that the intensity of the moments of insight reported by participants correlated with levels of aesthetic appreciation—in other words, the bigger the sense of ‘aha’, the more the participants reported liking the image. This and similar studies ([Muth et al., 2013](#)) suggest that the experience of suddenly seeing hidden structures within complex stimuli is associated with a pleasurable moment of insight. We suggest that our students experienced a similar ‘Aesthetic Aha’ ([Muth and Carbon, 2013](#), p. 28) when they began to ‘see’ the structure of language. For example one student in our previous research, described a satisfying moment of insight as they realized the extent of their (albeit tacit) linguistic expertise:

It is kind of gratifying when you finally get it and you think, ah! I knew what that was all along, but I didn’t know what it’s called! ([Ainsworth and Bell, 2020](#), p. 605)

As noted by [Reber \(2019, p. 457\)](#), Aha moments, where information is integrated in a new way, ‘combine understanding with the aesthetic’ and are signaled by a feeling of pleasure. While the aesthetic dimension comes from the learner’s newfound ability to appreciate the coherence of language as a structural system, the epistemic dimension comes from the sense of understanding how all the pieces map onto their existing procedural knowledge. In the words of [Fisher \(1998\)](#), p. 31 ‘the mind says ‘Aha!’ in the aesthetic moment when the spirit says ‘Ah.’

ii. Of language as an artifact...

When learning about grammar, students’ attention is drawn to language as an object of inquiry; they are now encouraged to consciously consider it rather than use it unreflectingly. An important vehicle for making language visible is the use of labels, which act to anchor the previously tacit knowledge onto a visible map of concepts and interrelations between them. At an epistemic level, acquiring knowledge of this map, requires a process of abstraction which provides the students with a virtual model of language, decontextualized from specific examples of language use. In aesthetic terms, the newly acquired metalinguistic labels may be conceptualized as providing beacons, illuminating the structure of language. It is this quasi-visual element of grammar learning which makes it a potential source of aesthetic pleasure, where ‘the “sensory” of the “aesthetic”’ ([Vasalou, 2015](#), p. 91) comes from a mental appreciation of the analytic structure rather than from actually seeing a physical object.

When considering the aesthetic dimensions involved in admiring language as an artifact, we identified some intriguing parallels between

learning about grammar and engaging with art. In his discussion of an ‘evolutionary perspective on aesthetic experience’ (2014, p. 37), [Consoli](#) emphasizes the central role of concrete tokens in aesthetic experience. For [Consoli \(2014\)](#), concrete tokens (e.g., a painting or temporal performance) are powerful sources of aesthetic experience because of their ‘material presence’ (p. 41). It is their materiality which grabs and holds the audience’s attention and facilitates the development of a virtual model, shared between the artist/performer and the audience. Grammar learning shares with art a reliance on concrete tokens. The ability to see ‘language as an artifact’ ([Myhill, 2012](#), p. 250) is mediated by metalanguage: grammar terms which allow teachers, students, linguists to think about and talk about language. We view this experience as aesthetic as it shares with more traditionally aesthetic endeavors, the phenomenon of ‘pleasure that comes with the perception of order’ ([Starr, 2023](#), p. 5). By bringing the structure of language into focus, learning about grammar provides students with an opportunity to make sense of the complexity of language, leading to the kind of ‘generalized sense of comprehensibility’ ([Starr, 2023](#), p. 5) that often emerges from aesthetic experience.

As well as supporting conscious access to an ordered picture of language, the metalinguistic labels themselves (adverbial, modal verb, subordinate clause, etc.) may also have an intrinsic aesthetic appeal. [Consoli \(2014\)](#) argues that the materiality of concrete tokens ‘is attractive and produces pleasure *per se*, and is appreciated and valued for itself’ (p. 41). This resonates with our experiences of teaching grammar, where students seemed to derive intrinsic pleasure from learning new technical terms. In our previous work ([Ainsworth and Bell, 2020](#)) we described how students talked excitedly about their love of labels and how grammar tapped into their thirst for ‘knowledge for knowledge’s sake’ (p. 602). Such conversations revolved around the pleasure that comes from simply being able to attach a new word to an existing concept, rather than for instrumental reasons. We argue that the process of learning new labels, which is central to opening up language as an artifact to learners, taps into a particular aspect of humans’ ‘epistemic hunger’ ([Dennett, 1991](#)), namely our status as logophiles (e.g., see [Crystal, 2013](#)). In this way, grammar learning has the potential to evoke intrinsic motivation in students ([Deci and Ryan, 2000](#)), tapping into the ‘active integrative tendencies in human nature assumed by SDT’ ([Ryan and Deci, 2020](#), p. 2), self-determination theory. These tendencies are proposed to ‘motivate individuals to assimilate ongoing experience into increasingly elaborated self-structures’ ([Ryan and Deci, 2004](#), p. 87). We speculate tentatively that students’ seemingly intrinsic drive to acquire new conceptual labels (in this case labels for linguistic structures) might be a manifestation of these broader tendencies.

iii. ...and the conscious monitoring and manipulation of language

One of the things that we found most interesting in our data was the fact that students’ new declarative knowledge seemed to follow them round outside the sessions, lurking in the background and catching them unawares. Students reported a new tendency to ‘see’ language through a grammatical lens while going about their day-to-day business:

‘I’ll be like reading a magazine and I’ll be like ooh, there’s the subject, there’s the object!’

I’ll be all weird like, ‘Ooh! But should that have a comma, because that’s a ... whatever’ ([Ainsworth and Bell 2020](#), p. 607).

They seemed to have developed a new layer of consciousness with respect to their language use, which ‘sees’ language as parsed into grammatical elements. As well as providing a scaffold for conscious monitoring and reflection on language (as seen in the quotes above), their recently acquired metalinguistic knowledge also provided a new platform for conscious manipulation of language:

I was using adverbials pretty much to start every single sentence. You know, like ‘however’, ‘therefore’. But then I was like, you don’t always have to do that. [...] I didn’t even know what an adverbial was six weeks ago. So then I was like, actually I can move that around (Ainsworth and Bell, 2020, p. 607).

Within this last example, the student is now able to imagine/simulate new ways of writing sentences, thanks to the virtual model of language that they have now acquired. By virtual, we refer to a model of language which allows a decoupling of language from its immediate use within specific contexts. This decoupling occurs as a consequence of acquiring knowledge of abstract grammatical categories. In the example above, now that this student understands the abstract ‘adverbial’ category, it has enabled them to perceive that the adverbial tends to be more mobile than other clause elements—i.e. it can often take a wider range of positions in relation to other parts of the sentence (e.g., Yesterday I went home/I went home yesterday). Consequently, they are now able to imagine different ways to express their ideas through language and to simulate the effect of different possibilities (e.g., by better predicting the effect that the adverbial would have if placed in different parts of the sentence).

This decoupling of specific exemplars of language use (e.g., real sentences) into abstract categories is analogous to the decoupling afforded by aesthetic experience in Consoli’s (2014) account of human evolution. According to Consoli (2014), one of the key adaptive features of aesthetic experience (in the context of early art) is that it ‘provides modal knowledge of and about possibility’ and ‘allows the exploration of possibilities in conceptual space on the basis of imagination’ (p. 40). Similarly, Marković (2012) notes that the creation of ‘virtual reality’ is a key characteristic of aesthetic experience. Consoli (2014) and others (e.g., Asma and Gabriel, 2019) argue that decoupling is an important stage in the human evolutionary story. The capacity to generate ‘imaginative simulations ... that are decoupled from the actual state of the world’ (Consoli, 2014, p. 40) evolves first in the form of dreaming (a precursor of aesthetic experience) and is also implicated in play, aesthetic experience and language. Each of these competencies has in common a metarepresentational structure which abstracts regularities or ‘isomorphisms’ (Asma and Gabriel, 2019, p. 161) from concrete experiences. In the context of art, Consoli (2014) argues that aesthetic experiences allow the artist to depict concepts through concrete tokens in a way that is decoupled from the concept itself (e.g., a cave painting may depict a horse that is not immediately present). This is a powerful tool for communicating ideas. There are of course, strong parallels between art and grammar in this regard, as grammar provides a common metarepresentational structure through which we can make our thoughts intelligible to one another, and through conscious reflection, we can make our own language use intelligible to ourselves.

While linguistic communication is, of course, effective without the need for any declarative knowledge of grammatical structure, this additional metalinguistic map, layered onto the underlying procedural

knowledge, enables what Consoli (2014, p. 45) describes as ‘a flexible, de-constrained use of imagination’. In this way, grammar provides a further layer of decoupling (or abstracting out from the particular), providing ‘the doorway into a wider aesthetic universe’ (Tooby and Cosmides, 2001, p. 19). This decoupling opens up the structure and generativity of language, which not only has instrumental advantages (e.g., by improving one’s authorial style) but also creates an aesthetic experience in itself: the experience of being able to ‘see’ the structure of our own language use as it unfolds in real time.

Consoli (2014) emphasizes the centrality of concrete tokens to the construction and sharing of virtual models by and between humans. We contend that the materiality of metalinguistic terms plays an analogous role, making visible to learners, ‘a universalizable virtual model’ (Consoli, 2014, p. 44) of language which they can then reflect on and consciously manipulate in a way that was not possible before. Explicit grammar learning may be conceptualized as concrete labels being attached onto the ‘nodes’ of the learner’s existing language structure, anchoring their tacit knowledge into an intelligible, concrete frame. This virtual model supports the development of a conscious awareness of how we use language to construct and share meaning with others. In this way, explicit grammar learning allows you to peer inward to reflect on the way that you as an individual represent and use language. For example, in the quote below a student is reflecting on how following the grammar sessions, they had developed an augmented understanding of the way that they use language:

This morning I was talking to my son and I was like, ‘Go!’ And I was like ‘Oh! You go’ and then I was thinking that was one of the things we’d spoke about in one of the other sessions. So it’s like, there’s actually a word missing from that sentence [the subject], (Ainsworth and Bell, 2020, p. 603)

In this moment of insight, the student realized that when we issue commands, we do not usually include the subject (We say ‘Go!’ rather than ‘You go!’) as the audience (in this case the participant’s tardy son) will automatically infer from the context that the command is being directed at them. In response to the student’s comment, the first author joined in with a reflection on the consequences of their own recent progress in terms of developing their knowledge about grammar:

I know what you mean because I often say ‘Get me them pens’ or ‘Get me them cakes’, you know like when I’m at home. And now I always think, ‘Oh, that’s interesting! Because what I’m doing is swapping a determiner for a pronoun’ (Ainsworth and Bell, 2020, p. 607).

While the above examples involve reflections on the individuals’ own language use may seem trivial, the discussion around them was lively. We speculate that the positive affect which accompanied these reflections may reflect an aesthetic feeling associated with self-understanding. Within both the philosophy and psychology literatures aesthetic experience is often associated with self-relevance experienced as being ‘touched from within’ (Vessel et al., 2013, p. 1). In that same study, while reporting neuroscientific markers of harmony (see also section i), Vessel and colleagues argued that ‘certain artworks can “resonate” with an individual’s sense of self’ (p. 6). While the research

of Vessel et al. reports on aesthetic responses to artwork that seem to be related to a drive for self-knowledge, we tentatively suggest that the metalinguistic knowledge that students acquire when learning about grammar might also generate aesthetic responses through a similar mechanism. In the latter case, it is the ‘picture’ of how language works that is provided by grammar learning which ‘reaches the self’ (*ibid*), fostering a satisfying sense of self-understanding.

- iv. ... to create desired meanings grounded in socially shared understandings

Learning about grammar is a socially driven and socially situated enterprise. At the very heart of language use is the desire to construct and share meaning within and between people. At a procedural level, grammar is clearly a tool which people use to make themselves intelligible to one another—a shared system for communication of ideas. But less has been written about the social dimensions of learning *declarative* grammar knowledge. We explore below some of the ways in which ‘the social’ is implicated in grammar learning, and the aesthetic character of each of these aspects.

Learning about others through learning about grammar. Learning about grammar helps us to develop knowledge of other people. By drawing attention to the way that people use language structures to communicate in different ways, grammar learning provides an additional tool for reflecting on people’s thoughts, behaviors and intentions. This particular affordance of learning about grammar lies at the intersection of grammar and pragmatics, which are ‘complementary domains within linguistics’ (Leech, 1983, p. 4), focusing on the interrelated areas of language structure and language use, respectively.

While the potential for grammar to foster learning about others did not feature in the data from our previous study, we will provide a brief reflection from the first author’s own experiences of learning about grammar to suggest a further parallel between grammar learning and more traditional aesthetic experiences. Firstly, to provide some context, it may be useful to note that the first author only acquired declarative knowledge of modal verbs relatively recently as they strived to bring themselves up to speed with the new requirements of the National Curriculum (DfE, 2013) in their role as a teacher educator. The quote below describes the first author’s reflections on the way in which becoming more aware of grammar, allowed them to become more aware of the subtle ways we communicate with each other, and of the pragmatic function of our particular authorial choices when constructing a particular communication act (e.g., an apology, request, demand, etc.).

After the grammar sessions, I was struck not only by the intrinsic satisfaction that I gained from acquiring the new grammar term ‘modal verb’, but by the way in which my newfound grammar knowledge spontaneously came to mind when I was reading my emails. For example, I could feel myself bristling when reading an overly direct presumptuous email bluntly making demands with no attempt to soften them. This feeling of irritation at receiving this kind of message was not unusual; but what was new was the addition of an another feeling—a combined sense of recognition and interest: recognition that what made the message so jarring was the lack of carefully chosen modal verbs to signal politeness; and interest, as to whether this absence was deliberate or unwitting.

This example illustrates how declarative knowledge about grammar can provide an additional tool for thinking (and talking) about the language choices that people make, allowing for a more concrete pinning down of the nature of those choices (e.g., rather than just a vague sense of knowing that someone ‘sounds rude’), which in turn can provide grounds for inferring intention of the language user. In this way, explicit grammar knowledge has the potential to help us to better understand the ways in which people position themselves through their use of language. This ability for grammar knowledge to open up new spaces for making sense of others’ behavior is something which is shared with other forms of aesthetic experience such as art and performance.

Aesthetic experience is often a vehicle for understanding others, including ‘helping individuals learn group behaviors and adapt to changes quickly’ (Starr, p. 11). Consoli (2014) argues that aesthetic experience co-evolved with ‘mind reading’—the capacity to understand ‘others’ complex mental states as integrated patterns of beliefs, desires, and intentions’ (p. 49). In the context of art, the painting, performance etc. acts to convey the artist’s intentionality. Language, of course, plays a similar but more direct role, where we use words as mediating signals (or tokens) of our thoughts, feelings and ideas. As described in section (iii), a key affordance of art is its ability to simulate ‘imaginings’. Language is also simulative in that it allows us to cultivate a particular imagining in someone else’s mind (e.g., I write the words ‘fat cat’ and you cannot help but picture one) (Asma and Gabriel, 2019). We suggest that the additional layer of tokens which declarative knowledge provides—in the form of a metalinguistic map—allows us to gain a deeper understanding of *how* we and others are using language to signal what *we/they* are thinking. While art and words are mediating objects that allow us to put ideas into people’s heads, explicit grammar knowledge provides a map of how the meaning is being mediated—what we might call a *meta-mediation map*. We argue that this concrete schematic of language provides a ‘mediated workspace’ analogous to that afforded by art, through which ‘subjects can become reflexively conscious of mind reading itself’ (Consoli, 2014, p. 48).

Sharing learning about grammar. The collective workspace which grammar opens up is something which learners seem surprisingly keen to share with others. Within our previous research, students talked animatedly about how they had been sharing their newfound knowledge about grammar with family and friends, at home and even in the pub. The quote from one of our students below, provides an example of the level of giddiness that grammar learning can foster along with a compulsion to share the excitement:

Every time I met somebody, I just had to tell them all about it. I was like, ‘Did you know that there is no future tense in the English language?!’ And they were like, ‘What do you mean?’ And then I was totally explaining it [...] I was like, ‘It’s amazing, isn’t it?! [...] It’s fascinating, because it’s something that’s so ... it’s one of the first natural things you do in the first year ... and then when you suddenly ... it just ... when you learn something, about a language that you have spoke for twenty years of your life, and you realize that there’s no future tense in your language, it just completely blows your mind. You’re like, ‘What?!’ (Ainsworth and Bell, 2020, p. 608)

We were struck by students' enthusiasm for talking about grammar beyond the sessions (for example, emailing us jokes about grammar and showing up in great numbers to the post-session focus groups to share their experiences of learning about grammar). They also reported trying to recruit new followers to what had unexpectedly become more of a grammar club than a series of lessons: 'We were like, "Are you coming? Honestly, it was really, really good!"' (Ainsworth and Bell, 2020, p. 609).

The fact that students were so keen to talk about grammar resonates with Consoli's observation that aesthetic objects are meant for sharing, as they provide 'a collective workspace dedicated to common, cultural processing' (2014, p. 42). The language of metalanguage allows for shared understandings and a shared vocabulary to talk about how language works, how it is used to create 'desired meanings grounded in socially shared understandings' (Myhill, 2012, p. 250), and to appreciate the wonder of this incredible human capacity. In addition to the specific affordances that might come from sharing knowledge about grammar with others (i.e., opening up the collective workspace to develop shared understandings about language), part of students' compulsion to share may be related to the aesthetic nature of language structure being unveiled:

'We care about aesthetics because we care about having aesthetic experiences. And, most of the time, we care about having aesthetic experiences together. Sitting next to each other in the movies, dancing, listening to music together' (Nanay, 2022, p. 29).

The eagerness with which students shared their learning about grammar felt akin to the impulse we have to tell our friends about a book, film or television series that we have just delighted in. This might be understood in relation to Nanay's suggestion that aesthetic phenomena can act as a 'glue for social cohesion', (Mechner, 2018, p. 297) providing a 'medium for sharing perceptions, information and beliefs' (*ibid*, p. 303). Indeed, from our subjective standpoint within our grammar lessons and follow-up focus groups, we experienced a sense of relational affective intensity, or 'transpersonal affects' (Anderson, 2009, p. 608) as students shared their journey into the 'aesthetic universe' (Tooby and Cosmides, 2001, p. 19) of grammar together.

Discussion

Summary of findings

In the preceding analysis we have presented an exploratory framework for considering the potentially aesthetic nature of learning about grammar. We have suggested that the layering of declarative knowledge on top of existing procedural knowledge has the potential to generate cognitive consonance as the new concepts map onto the learners' tacit understanding and experience of language. We speculate that the representational harmony which learners experience as the structure of language suddenly emerges from the shadows might be accompanied by an aesthetic-epistemic feeling of fittingness (Todd, 2018). We have further argued that the 'material presence' (Consoli, 2014, p. 41) of metalanguage may be central to the potential of grammar learning to evoke aesthetic experience. These concrete tokens support the development of a

virtual map, which provides a metacognitive platform for reflection on and manipulation of language. Here there are further parallels with more traditional aesthetic experiences. While art (and also language) involves the construction of virtual realities by decoupling concepts from their immediate referents (e.g., a painting of a cat represents the cat without it actually being there; Consoli, 2014), metalanguage supports decoupling of grammar elements from their immediate use within specific contexts. This decoupling process enables conscious reflection on one's own language use, which supports self-knowledge and may lead to an aesthetic experience of being 'touched from within' (Vessel et al., 2013, p. 1). It also allows 'simulative imaginings' (Consoli, 2014, p. 49), which may support diversification of the language user's grammatical repertoire. We have argued that learning about grammar also has social relevance. Declarative knowledge, when brought together with pragmatics, provides an additional tool for 'mind reading' – a capacity that is implicated in other aesthetic endeavors. And finally, we have suggested that as with other forms of aesthetic experience, grammar knowledge is best shared with others, providing a collective workspace for exploring socially shared understandings.

Significance for disciplinary aesthetics

To the authors' knowledge, this is the first time that the potential of grammar learning to evoke aesthetic experience has been explored in depth. We have identified a number of facets of learning about grammar that make it a potentially rich source of aesthetic pleasure. In this way we contribute to the expanding field of 'disciplinary aesthetics' (Wickman et al., 2022, p. 719), which argues for the importance of considering the aesthetic dimensions of all curriculum areas not just the arts. Our findings contribute to the growing body of evidence which suggests that aesthetic experience plays an important role in learning and meaning-making (Wickman, 2006; Vessel et al., 2013; Lemke, 2015). Aesthetic experience has been argued to serve the epistemic goal of knowing (Csikszentmihalyi and Robinson, 1990; Consoli, 2014), making it particularly advantageous to 'infovores' (Biederman and Vessel, 2006) like humans (Starr, 2023). In fact Starr (2023) argues that aesthetic experience 'emerges as a necessary outcome of the way humans learn and the parameters of human learning' (p. 2). The arguments presented above provide support for the notion that cognition and affect are intertwined and for the impossibility of 'separating affect from the moment of knowing' (Wickman et al., 2022, p. 720). Specifically, we have speculated that aesthetic-epistemic feelings of fittingness (Todd, 2018) may emerge as learners perceive a resonance between their outer (metalinguistic labels being learnt) and inner worlds (existing tacit knowledge of language). In this way we have contributed to thinking in relation to the relationship between perceptual insights (in this case suddenly 'seeing' the structure of language) and aesthetic pleasure (Consoli, 2015). As well as supporting meaning-making at a processual level (e.g., by signaling a state of cognitive consonance), aesthetic experience may also foster meaning in life, which comes in part from being able to make sense of your life and the world around you (De Ruyter and Schinkel, 2022). We have contributed to understandings around the relationship between meaning in life and disciplinary aesthetics by beginning to explore some of the ways in which learning about grammar might foster self-knowledge and knowledge of others.

From a methodological perspective, we have added to the growing body of work in disciplinary aesthetics which adopts a synthetic approach (see Special issue: Wickman et al., 2022). In order to avoid the limitations associated with using pre-defined categories of aesthetics to generate the exploratory framework presented within Table 1, we started from the bottom up, using our data as an initial basis for the development of our arguments. At the point of data collection, neither the students nor the study authors had aesthetics in mind. Rather we were engaged in an open-ended exploration of what happens when students need to develop a substantial body of declarative grammar knowledge quickly (in order to prepare for teaching the National Curriculum). The focus on aesthetics occurred *post hoc*, as we were struck by the affective dimension within the students' narratives. By adopting this 'bottom-up' approach, we were able to focus on the 'emergent interactions' (Wickman et al., 2022, p. 723) that occurred when students engaged with grammar learning, rather than attempting to fit a preconceived aesthetic framework onto their experiences. In addition, by adopting an interdisciplinary lens we have been able to identify resonances between our students' responses to learning grammar and ideas from the fields of evolutionary aesthetics, philosophy, cognitive psychology and neuroscience. These resonances were mobilized to create a speculative framework for understanding the aesthetics of grammar learning, which in turn has significant implications for education.

Towards a comparative disciplinary aesthetics

A central aim of the field of disciplinary aesthetics is to explore the aesthetic potential of learning within specific disciplines (Wickman et al., 2022). One might therefore wonder whether the framework set out within Table 1 is unique to explicit grammar learning or might also be applicable (in part or in full) to other types of learning. As an initial attempt to address this question, we will briefly compare explicit grammar learning (ELG) with two other examples of learning: explicit learning of conceptual metaphors (ELM) and explicit learning of walking (ELW).³ We will briefly speculate on the extent to which the epistemic and aesthetic dimensions set out within Table 1 might apply to these other types of learning. These tentative comments illustrate that we are not arguing that explicit grammar learning is the only potential source of the kind of aesthetic-affective responses that we observed among our students. Rather, we are suggesting that there are likely to be both commonalities and differences across different subject areas/types of learning in terms of their potentiality for evoking aesthetic experience.

The two other types of learning which we will compare with ELG—ELM and ELW provide useful reference points as they each share with grammar the characteristic of bringing previously tacit knowledge into consciousness. Given that one fundamental aspect of our thesis in this paper is that developing declarative knowledge of grammar from procedural knowledge can give rise to a particular epistemic-affective reaction, one important question is whether explicit learning about grammar is different in kind from other instances of learning where

there is a shift from procedural to declarative knowledge. Beginning with the case of ELM, humans frequently, and largely unwittingly, use metaphor within their everyday language. For example, phrases such as *warm welcome* and *cold stare* are used commonly within speech, usually without the speaker being conscious of their metaphoric nature (Lakoff and Johnson, 1980). If a student develops declarative knowledge of this existing procedural knowledge, e.g., by attending a cognitive semantics lecture on conceptual metaphor, then the structure that motivates such expressions (i.e., AFFECTION IS WARMTH; Lakoff and Johnson, 1980; Grady, 1997) will then be revealed to them. ELM might therefore have the potential to evoke an aesthetic experience as students 'see' the structure of this particular aspect of language appearing from the shadows. In the case of ELW, a student acquiring knowledge *about* the process of walking (e.g., as part of their medical or physical therapy training) is unlikely to have the same kind of aesthetic experience, which we have likened to Gestalt detection, because arguably learning about walking does not involve the unveiling of an overarching structure in the way that it does for ELG and ELM. Learning about walking does, however, share with the other types of learning, its place at the nexus of novelty and familiarity, so it may be that ELW has the potential to generate an aesthetic experience of some kind due to it affording the opportunity for learners to see an aspect of their everyday behavior (walking) in a new light.

ELM is closer to ELG than ELW as it sits within the same broad area of learning about language. This means that we might expect ELG to share, at least to some extent, grammar's potential to evoke aesthetic experience. For example, ELM shares with ELG the potential to encourage students to develop an extra layer of self-knowledge—in the case of ELM, knowledge about conceptual organization and how we use metaphors to map between conceptual domains (Lakoff and Johnson, 1980). In a broader sense, if ELM occurs within the context of a course on cognitive semantics/cognitive linguistics it has the potential to open up to learners the relationship between mind and meaning. In this way, we might wonder if ELM could have the potential to provide a similar aesthetic experience of being 'touched from within' (Vessel et al., 2013, p. 1) to that described above in relation to ELG. ELW on the other hand, also involves knowledge of the self, but this involves acquiring an understanding of motor processes rather than cognition, and while it may well have the potential to give rise to aesthetic-epistemic feelings, this would likely be underpinned by a different (but perhaps partially overlapping) set of epistemic and aesthetic dimensions. Similarly, even though ELM shares many commonalities with ELG in terms of the types of learning invoked, we would not expect the *aesthetic profile* to be identical. For example, we might speculate that ELG and ELM share the potential for fostering 'simulative imaginings' (Consoli, 2014, p. 49), given that they both provide a *meta-mediation map* of the way in which we use language to conjure images in the minds of others. However, arguably, ELM learning does not afford the same opportunities for manipulating and experimenting with language as ELG (or at least not to the same extent), and therefore we might not expect it to harbor the aesthetic potential that comes a new lens through which to 'see' language as a structure of manipulable building blocks. In fact, it is possible that the more distal ELW, may share some overlap with ELG in this regard. When patients who are recovering from stroke re-learn how to walk, declarative knowledge about walking is sometimes used to support them in re-developing their procedural knowledge of walking, e.g., by introducing concepts. One of the approaches used to support stroke

³ With thanks to an anonymous reviewer for suggesting these examples.

patients' rehabilitation involves engagement with virtual reality environments (e.g., Kim and Kaneko, 2023). Within these programs patients receive explicit feedback on their walking movements, which is presumed to activate explicit learning (Taylor et al., 2014). One might speculate as to whether these virtual reality interventions to support ELW, have the potential to stimulate aesthetic experience due to their simulative nature.

In summary, we have argued that each subject area is likely to have its own aesthetic profile, which will be defined by the particular kinds of learning involved. Given the overlap across subjects in terms of the kinds of learning being promoted and the associated cognitive mechanisms (e.g., connecting procedural and declarative memories), these profiles may contain shared aspects across subjects. We suggest that consideration of the three dimensions shown within Table 1—the key characteristics of the type of learning and the associated epistemic and aesthetic dimensions—might be a useful framework for exploring the aesthetic potential of other subjects. We argue that such a framework might be generated through bringing together learners' first-hand experiences of engaging with the subject with insights from the literature about the kinds of learning processes which they highlight as being most pertinent to how it *feels* to engage with that subject.

Pedagogical implications

Aesthetic experience has been argued to be 'both epistemically motivating and epistemically inventive' (Schellekens, 2022, p. 123). In other words, aesthetic experience has the potential to spur us on towards our overarching aim of knowing, while also fostering creativity. Aesthetic experiences have the potential to promote learning gains by enhancing motivation and guiding learners towards a 'sweet spot' in terms of learning gain (Starr, 2023, p. 10). Aesthetic experiences have also been argued to foster broader flourishing (Lomas, 2016). Yet formal education remains focused on preparing learners to be economically viable citizens (Reber, 2019; De Ruyter and Schinkel, 2022) and the role of aesthetics remains largely unexplored within pedagogical inquiry and practice, especially within the area of language learning (Reber, 2019). Our findings demonstrate that learning about grammar has the potential to generate rich aesthetic experience. Consideration of the aesthetic characteristics of grammar learning (and indeed of other curriculum areas) leads naturally to exploration of how such aesthetic aspects might best be harnessed within the classroom. While a full exploration of what might constitute an aesthetic approach to teaching grammar is beyond the scope of this paper, we will make some tentative preliminary remarks about the potential of the exploratory framework presented in Table 1 to inform pedagogical inquiry and practice.⁴

⁴ The students described in this paper have full control of English, yet typically very little metagrammatical knowledge. Students learning English as a second or other language, by contrast, typically do not have full procedural knowledge (they are learners, after all) and yet depending on contextual factors many have some metalinguistic knowledge. In this section, therefore, we limit our discussion to 'monolingual native speakers studying the grammar of their first language'.

Making grammar 'insight-full'. One of the ways that educators can cultivate aesthetic experience is to provide opportunities for students to experience the kind of 'aesthetic aha' (Muth and Carbon, 2013, p. 28) experiences that we reported above. Aha-experiences have been shown to foster positive attitudes in other curriculum areas (e.g., mathematics), sometimes dramatically so (Liljedahl, 2005). The enthusiasm with which our students spoke about grammar and their compulsion to bring others along for the ride, suggests that pedagogies for teaching grammar (and perhaps other subjects) which provide the space for moments of insight to be 'sparked' might foster intrinsic motivation and enjoyment. Liljedahl (2005) identified two categories of aha moments experienced by students learning mathematics: those relating to teaching (where the teacher revealed something to them) and those relating to discovering (where the insight came from working something out themselves). As one might expect, the latter category was found to be far more prevalent, suggesting that students are more likely to experience moments of insight when they are engaged in solving problems themselves. Liljedahl (2005) suggest that when trying to cultivate an environment conducive to moments of insight, it is important to provide students with plenty of time to explore and talk about problems in groups without too much intervention from the teacher (see also Bell and Ainsworth, 2019). More recently, Brady et al. (2022) have also suggested that collaborative work may foster aha experiences, providing evidence that group work can support 'the emergence of tacit knowledge onto the plane of the explicit' (p. 230). While this research was conducted in the context of mathematical modeling, given the parallel emphasis on bringing tacit knowledge to the fore within grammar learning, these findings may be useful in informing thinking around how to foster insightful moments when develop students' metalinguistic understanding. From a methodological perspective, observation of students engaging in group work may be a promising approach for exploring the aesthetic dimensions of grammar learning, as Brady et al. (2022) argue that:

using the interactional dynamics of groups as a lens into tacit knowledge can provide a means of studying processes that are hidden and inaccessible in individuals, through their manifestation in the social space of interaction (p. 230).

As well as harnessing the potential for group dynamics to foster (and make transparent) conceptual transformation, we suggest that opportunities for moments of insight within grammar learning might be maximized when grammar teaching is grounded in real life examples of language use. In order for students to achieve cognitive consonance with the declarative knowledge being learnt, it needs to be brought into contact explicitly and meaningful with their own language use. This aligns with Myhill's (2013) pedagogical principles for teaching grammar, which include the suggestion that metalanguage 'is always explained through examples and patterns' and that 'links are always made between the feature introduced and how it might enhance the writing being tackled' (2013, p. 105). Interestingly Myhill (2013) also highlight the benefits of collaborative work, 'encouraging critical conversations about language and effects' (p. 105).

Harnessing the materiality of metalanguage. Another promising approach to harnessing aesthetic experience might involve capitalizing on the 'materiality' or concreteness of metalanguage. According to Consoli (2014), concrete tokens (in this case metalinguistic labels) mediate aesthetic experience by guiding and prescribing imagination

in the construction of a virtual model. We suggest that aesthetic experience might be maximized by adopting strategies which are designed to support the learner to 'see' language in terms of abstract chunks/categories. Blair's (2019) treatise of 'the ornament of grammar' provides an interesting experiment into how grammar may be interpreted visually, as a 'means of 'seeing' a voice lending to thought at a detailed level' (p. 137), however, this work has a theoretical rather than a pedagogical focus. At a more practical level, we might take advantage of the materiality (Consoli, 2014, p. 41) of metalanguage by using carefully chosen visual scaffolds to support the process of mapping new grammar terms onto existing tacit knowledge. For example, Myhill (2013) describe a lesson focusing on 'how modal verbs can express different levels of assertiveness or possibility in persuasion' (p. 105). Students first explore modal verbs in famous speeches before they are asked to have a go at writing their own persuasive speeches. When analyzing this task, we might consider the concrete label of 'modal verb' to serve as a potential anchor for students' discussions around authorial choices. Without the term modal verb, it would arguably be harder to pin down and talk about those choices and their effects within the speeches. In this lesson the students are provided with a list of modal verbs to refer back to, providing a visual scaffold which makes the category of modal verbs (which the students may still be acquiring at an explicit level) visible to the students. While Myhill (2013) do not refer to aesthetics explicitly, it is striking how many words there are within the article that are associated with the domain of aesthetics e.g., 'to see how language works' (p. 105); 'making visible and explicit the authorial choices' (p. 105); 'makes the process of writing more visible' (p. 108); 'to see the process of writing as a process of design' (p. 108). While Myhill (2013) argue that the grammar terms should not be the key focus of a lesson, they suggest that the explicitness that they bring is useful as a vehicle for 'see[ing] through language in a systematic way' (Carter, 1990, in Myhill, 2013, p. 109). Similarly, in their pedagogical guidebook for teachers, Corbett and Strong (2014, p. 101) recommend using visual strategies for teaching grammar with the following advice: 'to draw attention to specific structures or words, use color to make the features stand out'. While our findings lend support to the rationale for such approaches, which draw attention to abstract grammar categories in very explicit ways, further research is needed into how the aesthetic affordances of concrete labels for categories might best be harnessed within the grammar classroom.

Encouraging 'simulative imaginings'. A related approach to maximizing the aesthetic potential of grammar might focus on the use of metalanguage to guide 'simulative imaginings' (Consoli, 2014, p. 49)—in other words using metalinguistic knowledge to support conscious reflection on and manipulation of language. Both Myhill (2013) and Corbett and Strong (2014) suggest practical activities for how this aesthetic dimension of grammar learning might be utilized within lessons. For example, Corbett and Strong (2014, p. 101) argue for a multisensory approach to grammar learning, underpinned by the principle 'hear it, say it, see it, move it, make it!' Many of the activities suggested by Corbett and Strong (2014) can be conceptualized as involving simulative imaginings as they involve students physically manipulating and playing with language structures in order to 'see' what is possible. For example, one activity involves students reading a passage where all the adjectives have been replaced with names of sweets (liquorice, jelly baby etc; Corbett and Strong, 2014). The children then imagine what the adjectives might have been. This

activity is simulative because the students need to try out possibilities and get an aesthetic sense of if it 'feels' right. Experimenting and analyzing the effects is an important part of 'beginning to understand the writer's craft and the possibilities open to a writer' (Myhill, 2013, p. 106); we argue that it is also an inherently aesthetic endeavor.

When considering what an aesthetically informed grammar pedagogy might look like, it might be fruitful to explore ideas from the burgeoning field of embodied education (Shapiro and Stolz, 2019). This relatively new area, seeks to apply insights from embodied cognition within the classroom, developing teaching approaches which foreground the complex interplay between mind, body and environment. Such approaches emphasize the importance of integrating firsthand knowledge (direct bodily experience) with secondhand knowledge (learnt through language, e.g., written texts or verbal explanations; Schwartz et al., 2005). For example, Goldberg (2008) describes an embodied approach to the teaching of reading, which involves children being trained to physically manipulate toys in a way that reflects what is happening in the story, before then learning how to perform an 'imagined manipulation' of what is happening in their heads. This approach, which supports the child in 'creating mental models from the text' (p. 307) was found to promote better attainment than a traditional approach involving re-reading the story. Goldberg's (2008) findings were interpreted as evidence in support of an embodied account of language comprehension where words, phrases and grammatical constructions are indexed (mapped) to concrete objects and events, 'thereby grounding the symbols and imbuing them with meaning' (p. 305). While the above example focuses on the process of learning to read, the process of learning about grammar also involves a mapping between firsthand and secondhand knowledge, and is widely conceived to be embodied. This leads us to speculate as to whether pedagogies analogous to those used by Goldberg (2008), where students are encouraged to engage in physical manipulation of grammatical elements in real sentences—see for example, Corbett and Strong's 'human sentence' activity (2014, p. 109)—before moving on to simulating the effects of different grammar constructions in their heads might be helpful in supporting learners to apply the simulative potential of grammar knowledge in an embodied way.

While on the surface, grammar may appear to be archetypically abstract, 'even syntax is shaped and given meaning by the contours of our bodily experience' (Johnson, 2017, p. 27). It therefore, stands to reason that pedagogies to promote grammar learning, should provide opportunities for embodied learning. A number of studies in the area of second language learning have explored the pedagogical implications of the embodied nature of grammar (e.g., Evans and Tyler, 2005; Suñer et al., 2023). In a recent study, Boieblan (2022) found that an embodied approach to teaching spatial prepositions (in, on, at, etc.), which foregrounded 'the geometric and functional properties of figure and ground and how these intersect in space' (p. 1391), led to learning gains for Spanish learners relative to the control group. To the authors' knowledge, there are no studies which have explored the pedagogical implications of 'the embodiment of language' (Johnson, 2018, p. 623) for teaching explicit grammar knowledge to native speakers. The potential transferability of embodied L2 approaches to explicit L1 grammar learning represents an interesting line of inquiry for future research.

Making room for mind reading. Finally, educators might consider emphasizing in their teaching the potential of metalinguistic understanding to support an understanding of authorial intentions—a

form of ‘mind reading’ (Consoli, 2014, p. 48). Such an approach might involve framing grammar as a collective workspace for understanding how different language structures are used to generate ‘desired meanings grounded in socially shared understandings’ (Myhill, 2012, p. 250). A simple example could involve asking learners to rank an assortment of emails or commands in relation to how polite they ‘feel’ or in terms of where you would place the author on a scale of how angry you think they are, using consideration of their language choices to explain their reasoning. As well as incorporating the aesthetic endeavor of mind-reading, these activities also tap into children’s procedural knowledge (sense of what’s right). This is advantageous in the sense that learners would be able to do these activities relatively easily, providing reinforcement for them that they are already ‘experts’ on language. This kind of approach to teaching grammar, which highlights what students already know, is in opposition to the common negative perception of grammar as a difficult subject likely to leave learners feeling ‘defeated by the operations of their own words’ (Kennedy, 2016, 00:07:50). We therefore tentatively suggest that in order to maximize the full aesthetic potential of grammar learning it might be beneficial to support learners in understanding the relationship between grammar and pragmatics with activities that draw upon their existing (but tacit) knowledge of how language is used to convey particular effects and intentions. Notably, while grammar is currently a very visible strand within the National Curriculum (DfE, 2013), pragmatics is not explicitly mentioned.

Concluding remarks

In summary this paper has taken an initial step towards conceptualizing the aesthetic dimension of learning about grammar, an area which has hitherto been overlooked. We have also begun, albeit briefly, to make some preliminary suggestions about what ‘metalinguistically aware teaching’ (Myhill, 2013, p. 110) might look like when viewed through an aesthetic lens. We hope that the speculative framework presented in Table 1 opens up a broader conversation around the aesthetics of grammar as a discipline and motivates further research in this area. Gaining a deeper understanding of the potential role of aesthetic experience within the grammar classroom (and education more generally) is crucial, not just because an aesthetically oriented approach might optimize learning, but because it can foster authentic engagement (Ainsworth and Bell, 2020) and human flourishing (Reber, 2019; De Ruyter and Schinkel, 2022).

References

- Ainsworth, S., and Bell, H. (2020). Affective knowledge versus affective pedagogy: the case of native grammar learning. *Camb. J. Educ.* 50, 597–614. doi: 10.1080/0305764X.2020.1751072
- Anderson, B. (2009). Affective atmospheres. *Emot. Space Soc.* 2, 77–81. doi: 10.1016/j.emospa.2009.08.005
- Arango-Muñoz, S., and Michaelian, K. (2014). Epistemic Feelings and Epistemic Emotions (Focus Section). *Philos. Inquiries* 2, 97–122. doi: 10.1080/09515089.2012.732002
- Asma, S., and Gabriel, R. (2019). *The Emotional Mind: The Affective Roots of Culture and Cognition*. Cambridge, MA: Harvard University Press.
- Bell, H., and Ainsworth, S. (2019). “Hard to know or hard to say? Developing Explicit Grammar Knowledge among Primary Student Teachers” in *Voices and Practices in Applied Linguistics: Diversifying a Discipline*. eds. C. Wright, L. Harvey and J. Simpson (York: White Rose University Press), 195–209.
- Bell, H., and Ainsworth, S. (2021). Difficulties assessing knowledge of grammatical terminology: implications for teacher education and teaching. *Lang. Aware.* 30, 97–113. doi: 10.1080/09658416.2020.1752701
- Biederman, I., and Vessel, E. A. (2006). Perceptual pleasure and the brain: A novel theory explains why the brain craves information and seeks it through the senses. *Am. Sci.* 94, 247–253. doi: 10.1511/2006.59.247
- Blair, S. (2019). The ornament of grammar. *J. Illus.* 6, 137–160. doi: 10.1386/jill_00008_1
- Boieblan, M. (2022). Enhancing English spatial prepositions acquisition among Spanish learners of English as L2 through an embodied approach. *Int. Rev. Appl. Linguist. Lang. Teach.* 61, 1391–1420. doi: 10.1515/iral-2021-0151
- Bourdieu, P. (1984). *Distinction: A social critique of the judgement of taste*. London: Routledge.

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by MMU Faculty of Education Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

SA: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. HB: Conceptualization, Data curation, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Brady, C. E., Borromeo Ferri, R., and Lesh, R. A. (2022). Tacit Knowledge and Embodied Insight in Mathematical Modeling. *Investig. Math. Learn.* 14, 215–234. doi: 10.1080/19477503.2022.2095781
- Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101. doi: 10.1191/1478088706qp0630a
- Carter, R. (1990). *Knowledge about Language*. London: Hodder and Stoughton.
- Chandrasekhar, S. (1979). Beauty and the quest for beauty in science. *Phys. Today* 32, 25–30. doi: 10.1063/1.2995616
- Cheng, L., Burgess, D., Vernooij, N., Solis-Barroso, C., McDermott, A., and Nambodiripad, S. (2021). The problematic concept of native speaker in psycholinguistics: Replacing vague and harmful terminology with inclusive and accurate measures. *Front. Psychol.* 12:715843. doi: 10.3389/fpsyg.2021.715843
- Consoli, G. (2014). The emergence of the modern mind: An evolutionary perspective on aesthetic experience. *J. Aesthet. Art Critic.* 72, 37–55. doi: 10.1111/jaac.12059
- Consoli, G. (2015). From beauty to knowledge: a new frame for the neuropsychological approach to aesthetics. *Front. Hum. Neurosci.* 20:290. doi: 10.3389/fnhum.2015.00290
- Corbett, P., and Strong, J. (2014). *Jumpstart! grammar: games and activities for ages 6–14*. Abingdon: Routledge.
- Crystal, D. (1995). Phonaesthetically speaking. *English Today* 42, 8–12.
- Crystal, D. (2013). *Interviewed by Tony O'Brien for British Council Serbia, 9 November*. Available at: <https://www.youtube.com/watch?v=SqkIv79KB7w> (Accessed October 10, 2018).
- Csikszentmihalyi, M., and Robinson, R. E. (1990). *The art of seeing: An interpretation of the aesthetic encounter*. Los Angeles: The J. Paul Getty Museum.
- Damasio, A. (1999). *The feeling of what happens: Body and emotion in the making of consciousness*. New York: Harcourt Brace & Co.
- De Ruiter, D., and Schinkel, A. (2022). “Education and meaning in life” in *The Oxford Handbook of Meaning in Life*. ed. I. Landau (New York: Oxford University Press)
- Deci, E. L., and Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and the self-determination of behavior. *Psychol. Inq.* 11, 227–268. doi: 10.1207/S15327965PLI1104_01
- Dennett, D. C. (1991). *Consciousness Explained*. London: Penguin Books.
- Dewaele, J. M., and Li, C. (2020). Emotions in second language acquisition: a critical review and research agenda. *Foreign Lang. World* 1, 34–39.
- Dewey, J. (1934). *Art as Experience*. New York: Minton, Balch & Co.
- DfE. (2013). *The national curriculum in England: key stages 1 and 2 framework document*. London: Department for Education.
- Dietrich, E., Fields, C., Hoffman, D. D., and Prentner, R. (2020). Editorial: Epistemic Feelings: Phenomenology, Implementation, and Role in Cognition. *Front. Psychol.* 11:606046. doi: 10.3389/fpsyg.2020.606046
- Dokic, J. (2016). IV–Aesthetic experience as a metacognitive feeling? A dual-aspect view. *Proc. Aristot. Soc.* 116, 69–88. doi: 10.1093/arisc/aow002
- Evans and Tyler (2005). Applying cognitive linguistics to pedagogical grammar: the English prepositions of verticality. *Rev. Bras. Lingüíst. Apl.* 5, 11–40. doi: 10.1590/S1984-63982005000200002
- Fisher, P. (1998). *Wonder, the Rainbow and the Aesthetics of Rare Experiences*. Cambridge, MA: Harvard University Press.
- Fishwick, P. (2006). *Aesthetic computing*. Cambridge, MA: The MIT Press.
- Girod, M., Rau, C., and Schepige, A. (2003). Appreciating beauty of science ideas: Teaching for aesthetic understanding. *Sci. Educ.* 87, 574–587. doi: 10.1002/sci.1054
- Goldberg, A. M. (2008). “Embodiment for Education” in *Handbook of cognitive science: an embodied approach*. eds. P. Calvo and T. Gomila (Amsterdam: Elsevier), 355–372.
- Grady, J. E. (1997). *Foundations of meaning: Primary metaphors and primary scenes [Unpublished PhD dissertation]*. Berkeley, CA: University of California.
- Hayn-Leichsenring, G., Vartanian, O., and Chatterjee, A. (2022). The role of expertise in the aesthetic evaluation of mathematical equations. *Psychol. Res.* 86, 1655–1664. doi: 10.1007/s00426-021-01592-5
- Hinsliff, G. (2017). *Pity our children—they're being turned into grammar robots at school* Gaby Hinsliff. The Guardian.
- Horwitz, E. K., Horwitz, M. B., and Cope, J. (1986). Foreign Language Classroom Anxiety. *Mod. Lang. J.* 70, 125–132. doi: 10.1111/j.1540-4781.1986.tb05256.x
- Hudson, R., and Walmsey, J. (2005). The English patient: English grammar and teaching in the twentieth century. *J. Linguist.* 41, 593–622. doi: 10.1017/S0022226705003464
- Jackson, A. Y., and Mazzei, L. A. (2013). Plugging one text into another: Thinking with theory in qualitative research. *Qual. Inq.* 19, 261–271. doi: 10.1177/1077800412471510
- Jacobsen, T., and Höfel, L. (2003). Descriptive and evaluative judgment processes: Behavioral and electrophysiological indices of processing symmetry and aesthetics. *Cogn. Affect. Behav. Neurosci.* 3, 289–299. doi: 10.3758/CABN.3.4.289
- Jakobson, B., and Wickman, P.-O. (2008). The roles of aesthetic experience in elementary school science. *Res. Sci. Educ.* 38, 45–65. doi: 10.1007/s11165-007-9039-8
- Johnson, M. (2017). *Embodied Mind, Meaning, and Reason: How Our Bodies Give Rise to Understanding*. Chicago: The University of Chicago Press.
- Johnson, M. (2018). “The Embodiment of Language” in A. Newen, BruinL. De and S. Gallagher *The Oxford Handbook of 4E Cognition*. Oxford: Oxford University Press, 623–640.
- Johnson, S., and Steinerberger, S. (2019). Intuitions about mathematical beauty: A case study in the aesthetic experience of ideas. *Cognition* 189, 242–259. doi: 10.1016/j.cognition.2019.04.008
- Kennedy, A. L. (2016). *A Point of View: the power of language*. For The BBC. Available at: <https://www.bbc.co.uk/sounds/play/b07glx87> (Accessed June 22, 2018).
- Kim, M., and Kaneko, F. (2023). Virtual reality-based gait rehabilitation intervention for stroke individuals: a scoping review. *J. Exerc. Rehabil.* 19, 95–104. doi: 10.12965/jer.2346114.057
- King, D., Ritchie, S., Sandhu, M., and Henderson, S. (2015). Emotionally intense science activities. *Int. J. Sci. Educ.* 37, 1886–1914. doi: 10.1080/09500693.2015.1055850
- Kosso, P. (2002). The Omniscient: Beauty and scientific understanding. *Int. Stud. Philos. Sci.* 16, 39–48. doi: 10.1080/02698590120118819
- Lakoff, G., and Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Lambek, J. (1989). Grammar as mathematics. *Can. Math. Bull.* 32, 257–273. doi: 10.4153/CMB-1989-039-x
- Leech, G. (1983). *Principles of pragmatics*. Harlow: Pearson.
- Lemke, J. (2015). “Feeling and meaning: a unitary bio-semiotic account” in *International handbook of semiotics*. ed. P. P. Trifonas (Dordrecht: Springer), 589–616.
- Liljedahl, P. G. (2005). Mathematical discovery and affect: the effect of AHA! experiences on undergraduate mathematics students. *Int. J. Math. Educ. Sci. Technol.* 36, 219–235. doi: 10.1080/00207390412331316997
- Lomas, T. (2016). Positive Art: Artistic Expression and Appreciation as an Exemplary Vehicle for Flourishing. *Rev. Gen. Psychol.* 20, 171–182. doi: 10.1037/gpr0000073
- Margulies, S. (1977). Principles of beauty. *Psychol. Rep.* 41, 3–11. doi: 10.2466/pr0.1977.41.1.3
- Marković, S. (2012). Components of aesthetic experience: Aesthetic fascination, aesthetic appraisal, and aesthetic emotion. *I-Perception* 3, 1–17. doi: 10.1068/i0450aap
- Marques, W. (2017). *An overview of the contemporary English language: changes and perspectives – interview with David Crystal*. Available at: <https://docs.google.com/viewerng/viewer?url=http://www.seer.ufu.br/index.php/dominiosdelinguagem/article/viewFile/37518/20934> (Accessed December 3, 2018).
- McMahon, J. (2015). Aesthetics is the grammar of desire. *Aesthetic Investig.* 1, 156–116. doi: 10.58519/aesthin.v1i1.12015
- Mechner, F. A. (2018). A Behavioral and Biological Analysis of Aesthetics: Implications for Research and Applications. *Psychol. Rec.* 68, 287–321. doi: 10.1007/s40732-017-0228-1
- Moles, A. (1973). *Théorie de l'information et perception esthétique*. Paris: Denoël.
- Muth, C., and Carbon, C. (2013). The aesthetic aha: on the pleasure of having insights into Gestalt. *Acta Psychol.* 144, 25–30. doi: 10.1016/j.actpsy.2013.05.001
- Muth, C., Pepperell, R., and Carbon, C. (2013). Give me Gestalt! Preference for Cubist artworks revealing high detectability of objects. *Leonardo* 46, 488–489. doi: 10.1162/LEON_a_00649
- Myhill, D. (2012). “The ordeal of deliberate choice: Metalinguistic development in secondary writers” in *Past, present, and future contributions of cognitive writing research to cognitive psychology*. ed. V. W. Berninger (London: Psychology Press), 247–272.
- Myhill, D. (2013). Playful explicitness with grammar: a pedagogy for writing. *Literacy* 47, 103–111. doi: 10.1111/j.1741-4369.2012.00674.x
- Nanay, B. (2022). “Unlocking experience” in *Aesthetic Life and Why It Matters*. eds. D. M. Lopes, B. Nanay and N. Riggle (Oxford: Oxford University Press)
- Olin, L. (2018). *Feelings for Knowing*. MidWest Epistemology Workshop.
- Reber, R. (2019). Making school meaningful: linking psychology of education to meaning in life. *Educ. Rev.* 71, 445–465. doi: 10.1080/00131911.2018.1428177
- Rovelli, C. (2022). *Helgoland: The Strange and Beautiful Story of Quantum Physics*. Harmondsworth: Penguin.
- Russell, B. (1919). *The study of mathematics. In Mysticism and Logic: And Other Essays*. London: Longman.
- Ryan, R. M., and Deci, E. L. (2004). *Handbook of Self-determination Research*. Rochester: University of Rochester Press.

- Ryan, R. M., and Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemp. Educ. Psychol.* 61:101860. doi: 10.1016/j.cedpsych.2020.101860
- Ryle, G. (1949). *The Concept of Mind*. London: Hutchinson.
- Schellekens, E. (2022). Aesthetic Experience and Intellectual Pursuits. *Aristotelian Soc. Suppl. Vol.* 96, 123–146. doi: 10.1093/arisup/akac003
- Schwartz, D. L., Martin, T., and Nasir, N. (2005). “Designs for knowledge evolution: Towards a prescriptive theory for integrating first-and second-hand knowledge” in *Cognition, Education, and Communication Technology*. eds. P. Gardenfors and P. Johansson (Mahwah, NJ: Lawrence Erlbaum), 21–54.
- Shapiro, L., and Stolz, S. A. (2019). Embodied cognition and its significance for education. *Theory Res. Educ.* 17, 19–39. doi: 10.1177/1477878518822149
- Starr, G. G. (2023). Aesthetic experience models human learning. *Front. Hum. Neurosci.* 17:1146083. doi: 10.3389/fnhum.2023.1146083
- Stockwell, P. (2009). *Texture: A Cognitive Aesthetics of Reading*. Edinburgh: Edinburgh University Press.
- Suñer, F., Roche, J., and Van Vossel, L. (2023). Bodily engagement in the learning and teaching of grammar: On the effects of different embodied practices on the acquisition of German modal verbs. *Rev. Cogn. Linguist.* 21, 35–63. doi: 10.1075/rcl.00126.sun
- Taylor, J. A., Krakauer, J. W., and Ivry, R. B. (2014). Explicit and implicit contributions to learning in a sensorimotor adaptation task. *J. Neurosci.* 34, 3023–3032. doi: 10.1523/JNEUROSCI.3619-13.2014
- Todd, C. (2018). Fitting feelings and elegant proofs: On the psychology of aesthetic evaluation in mathematics. *Philos. Math.* 26, 211–233. doi: 10.1093/philmat/nkx007
- Tooby, J., and Cosmides, L. (2001). Does beauty build adapted minds? Toward an evolutionary theory of aesthetics, fiction and the arts. *SubStance* 30, 6–27. doi: 10.2307/3685502
- Ulrich, R. S. (1983). “Aesthetic and affective response to natural environment” in *Behavior and the Natural Environment*. eds. I. Altman and J. F. Wohlwill (Boston, Mass: Springer), 85–125.
- Vasalou, S. (2015). *Wonder: A Grammar*. New York: State University of New York Press.
- Vessel, E. A., Starr, G. G., and Rubin, N. (2013). Art reaches within: aesthetic experience, the self and the default mode network. *Front. Neurosci.* 7:258. doi: 10.3389/fnins.2013.00258
- Vogl, E., Pekrun, R., Murayama, K., and Loderer, K. (2019). Surprise, curiosity, and confusion promote knowledge exploration: Evidence for robust effects of epistemic emotions. *Front. Psychol.* 10:2474. doi: 10.3389/fpsyg.2019.02474
- Watson, A. (2012). Navigating ‘the pit of doom’: Affective responses to teaching ‘grammar’. *Engl. Educ.* 46, 22–37. doi: 10.1111/j.1754-8845.2011.01113.x
- Wickman, P. O. (2006). *Aesthetic Experience in Science Education: Learning and Meaning-Making as Situated Talk and Action*. London: Routledge.
- Wickman, P.-O., Prain, V., and Tytler, R. (2022). Aesthetics, affect, and making meaning in science education: an introduction. *Int. J. Sci. Educ.* 44, 717–734. doi: 10.1080/09500693.2021.1912434
- Williams, J. (2019). *The Aesthetics of Grammar: Sound and Meaning in the Languages of Mainland Southeast Asia*. Cambridge: Cambridge University Press.
- Zeki, S., Romaya, J. P., Benincasa, D., and Atiyah, M. F. (2014). The experience of mathematical beauty and its neural correlates. *Front. Hum. Neurosci.* 8:68. doi: 10.3389/fnhum.2014.00068
- Zembylas, M. (2021). *The affective turn in educational theory*. Oxford Research Encyclopedia of Education. Retrieved 30 Aug. 2023, Available at: <https://oxfordre.com/education/view/10.1093/acrefore/9780190264093.001.0001/acrefore-9780190264093-e-1272>. (Accessed August 30, 2023).