

The Neuroaesthetics of Art and Design Education

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Abstract

Teaching is increasingly defined through the syntax of cognitive science, by retrieval practice, spaced learning, and interleaving, generating a computational rhythm for learning as a system of inputs and outputs that builds up an individual's memory over time. This, I argue, is at odds with the choreography of art and design education as an aesthetic, social, and material practice. An alternative mapping is required to fully understand the chronology of learning that takes place in and through the subject of art and design with human and nonhuman others. Drawing from a review of research in the field of Neuroaesthetics, I will seek to defend the unique temporality of art and design education and imagine different visualisations of learning in the subject beyond the computational.

Keywords

affect, art and design teacher education, classroom choreography, cognitive science, core content framework, creative project, early career framework, neuroaesthetics, stopping for knowledge

Introduction

In this paper I aim to present an imaginative response to recent changes within the rhythm of art and design teaching that, in my role as Art & Design PGCE¹ Subject Leader, I have observed in English secondary schools. It is a change I attribute to the growing influence of cognitive science in education discourse. The field of cognitive science combines psychology (which explores thinking processes) and neuroscience (which connects thinking processes with specific brain activity), as well as linguistics, and computer science, to study cognition. However, within the field of cognitive science, over the last 30 years, it is neuroscience that has most captivated the imagination of those interested in studying the mind (Donoghue & Horvath 2017). International excitement about the potential of neuroscience to revolutionise education has been fueled by the development and availability of non-invasive and mobile brain imaging methods (Ansari *et al.* 2012; Janssen

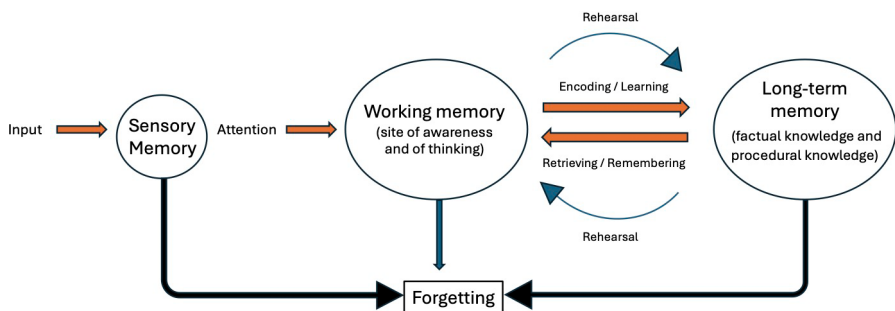
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et al. 2021). The anticipated revolution is seen in worldwide investment in the emerging field of neuroeducation, which brings together cognitive scientists and educational researchers to 'fix' the problems inherent in education (Ansari *et al.* 2012; Donoghue & Horvath 2017). Here I will firstly discuss the problems of translating cognitive science principles for the teaching of art and design, before suggesting ways that emerging findings from a little-known area of neuroscience, *neuroaesthetics*, may animate the rhythms of the art and design classroom.

The application of cognitive science to English classrooms has been accelerated through such mechanisms as the Early Career and Initial Teacher Education (ITE) Core Content frameworks (2019a; 2019b). The compulsory Early Career Framework (ECF) was launched in 2019 as a two-year 'evidence based' induction programme for newly qualified teachers. Developing an understanding of working memory and long-term memory is a thread that runs throughout the ECF with a very strong focus within the recommended reading on cognitive science texts that explore ways to build students long-term memory in the classroom. These texts also form the evidence base for the ITE Core Content Framework (CCF), that sets out the mandated minimum entitlement for trainee teachers.

Three texts within the recommended reading for the ECF and CCF (DFE 2019a; DFE 2019b) are written by cognitive scientist Daniel T. Willingham. In Willingham's book *Why don't students like school? A Cognitive Scientist Answers Questions About How the Mind Works and What It Means for the Classroom* the importance of memory to learning is a central theme. He provides a flow diagram to illustrate his model of mind (Willingham 2009, p. 55). The diagram shows the process whereby a student is prompted to pay attention to a concept, causing it to enter their working memory and, through the repetition of learning and remembering, enters their long-term memory. A similar diagram appears in a report commissioned by the Education Endowment Foundation (EEF) on Cognitive Science in the Classroom (Perry *et al.* 2021a, 2021b) in which the process of learning (encoding) and remembering (retrieving) is labelled 'rehearsal'. It is these two diagrams (that I have combined in Figure 1) that form the basis for the imaginings I present in this paper.

Significantly for the subject of art and design, Willingham distinguishes between *knowledge understanding* and *knowledge creation*, seeing quality examples of



The cognitive science model of mind (combining those provided by Willingham and Perry *et al.*).

Figure 1

The Cognitive Science Model of Mind (Combining Those Provided by Willingham 2009 and Perry *et al.* 2021a, 2021b).

the latter as unattainable for those who have not had years of practice (rehearsal) in a given field. This leads him to suggest *knowledge comprehension* more accurately describes the kind of knowledge that is obtained through schooling, suggesting that ‘a student may not be able to develop his own scientific theory, but he can develop a deep understanding of existing theory’ (Willingham 2009, p. 141). He does not write specifically about art and design but in relation to Music he states,

A music class may well emphasize practice and proper technique, but it may also encourage students to compose their own works simply because the students would find it fun and interesting. Is such practice necessary or useful in order for students to think like musicians? Probably not. Beginning students do not yet have the cognitive equipment in place to compose, but that doesn’t mean they won’t have a great time doing so, and that may well be reason enough. (Willingham 2009, p. 142)

He is therefore sceptical about the cognitive worth of students engaging in creative work, beyond it providing enjoyment. Drawing on findings from Neuroaesthetic research, I will return to this later in my discussion.

Troubling the certainty of the evidence base

Hordern and Brooks address the foundational assumptions of the evidence base of the ECF and CCF, through a survey of the recommended literature that both cite and point to a ‘new scientism’ at play ‘that concentrate(s) on hypothesis-driven and quasi-experimental strategies of inquiry’ (2023, p. 804). The privileging of one tradition of research, they suggest, marginalises the ethnographic, narrative, practice-based, philosophical and historical studies that form the ‘rich variety of traditions’ (ibid, p. 803) of educational research in the UK and worldwide that acknowledge the complexity of what it is to teach and be a teacher. This marginalisation of more interpretive forms of research is problematic for art and design education where, due to the ‘intrinsically social’ characteristic of artmaking, qualitative research dominates (Hickman 2008, p. 16).

Whilst acknowledging that there is a convincing case that can be made of the need for a ‘systematic knowledge base’ or a ‘reservoir of knowledge’ that teachers can draw upon in their practice, Hordern and Brooks are sceptical that this is possible without a ‘complex process of recontextualisation’ that requires a coexisting guiding purpose to inform such translation (2023, p. 807). A significant guiding partner in the development of the evidence base for the ECF and the CCF has been the EEF whose logo appears prominently on both documents. The EEF is one of nine national independent What Works Centres that ‘help to ensure that robust evidence shapes decision-making’ across their associated areas of government policy (Evaluation Task Force 2013). It is arguably this ‘what works’ strategy that provides the guiding purpose of the ECF and CCF and it is a contentious one. Krejsler, responding to a comparable ‘what works’ agenda in Danish education policy, refers to the term ‘what works’ as a ‘floating signifier’—something that establishes a broad agreement about what should be held as ‘legitimate truths within different policy areas... set(ting) new agendas and dislocat(ing) established truths by expressing flexibly the interests of dominant configurations of stakeholders’ (Krejsler 2017, pp. 23, 24). A floating signifier ‘dislocates established truths’ by

apparently representing a commonsense view that is hard to contradict. Why wouldn't you support finding out 'what works' in the classroom? It is only when the details of how such floating signifiers are to be operationalised in practice that the consensus surrounding them is found to be weak. As Knight and Sullivan maintain in their critique of the evidence base for 'what works' in ITE in relation to the CCF, it erroneously assumes 'that teaching is technically simple, so long as the appropriate strategies are implemented faithfully' (2022, p. 147). Similar oversimplification is noted by Murtagh *et al.*, who criticise the generic content of the ECF that fails to provide new teachers with any subject specific context for the understanding of learning that it presents (2022). The 'floating signifier' of 'what works' is in danger of being found to be devoid of real meaning, in any way that art and design teacher educators would recognise, for their trainee and early career teachers in the context of the classroom. The evidence put forward by the EEF pays scant attention to established ways of forming agreement around the 'bestness' of a knowledge base (Hordern & Brooks 2023). It replaces the consensus of the art and design education academic community to decide what makes professional knowledge in the art and design classroom.

The unique context of art and design education

In England, students' attainment in art and design at the end of secondary level is assessed purely through submission of a portfolio of individual creative projects (split 30–40% between projects set internally as 'course work' and an 'exam' project set externally by the exam board). For Thomson & Hall (2021) the individual creative project and the portfolio constitute signature pedagogies of art and design and rely on a very different rhythm to teaching than the 'whole class' model that is dominant in other curriculum subjects, and which cognitive science principles often assume. The creative project, they suggest, requires teachers to scaffold sequences that both build technical competence *and* creative strategies, nurture connections with students as a foundation for working together on agreeing the trajectory for their creative work and communicate with students in ways that situate them to 'think and act as artists' (Thomson & Hall 2021, p. 609). This description of 'best practice' in art and design teaching, provided by 'experts' in the field directly contradicts Willingham's claim that the job of teaching is not to encourage students to think like real scientists, mathematicians, historians ... and artists (Willingham 2009, p. 127).

Donoghue & Horvath (2017) observe that the findings of cognitive psychology are often applied to education in ways that are preoccupied with academic attainment in the form of remembering content to be reproduced in examination contexts. It is implied by the label 'rehearsal' in the model of mind illustration previously described (Figure 1)—the word rehearsal suggesting a future end point where the individual will be required to 'perform' what it is they have ultimately remembered. This relies on a distorted understanding of the science, leading to a narrow focus on 'factual' or declarative knowledge (what one can say about what one knows) rather than a more expansive understanding of learning (*ibid*)—perhaps not surprising given the high stakes of examination results for students, their teachers and their schools. It is a distortion that explains the contortions of practice that some art and design teachers go through in order to fulfil senior management directives to roll out memory recall tasks in their teaching, such as

introducing written tests in lessons, as a form of ‘retrieval practice’—an unnecessary introduction, as retrieval practice happens anyway, any time a teacher, or peer, asks a student to recall or repeat an aspect of expertise without support. The requirement to be constantly rehearsing ‘knowledge’ can also be seen in increasing amounts of time spent at the beginning and end of lessons recalling content through ‘do now’ tasks or extended teacher questioning, thus taking time away from making. My time spent in art and design classrooms in London schools suggests that cognitive science, in its focus on repetitive rehearsal, is gradually changing the cadence of art and design teaching. As I shall go on to argue, the focus on remembering as the most important outcome in art and design education is at odds with other established learning outcomes that rely on an alternative rhythm to learning.

The imaginative act of teaching from cognitive science

Though expressing enthusiasm for the potential of future research in the field of cognitive science for education, Perry *et al.* (2021a, 2021b) caution that the current research base for cognitive science principles such as spaced learning, interleaving, retrieval practice, dual coding, and cognitive load reduction has often been completed in experimental conditions far removed from real-world contexts and in such a narrow range of subject areas that its usefulness to actual classrooms cannot be guaranteed (none of the research included in their review was conducted in an art and design context). It is possible to suggest therefore that another floating signifier might also be that of ‘cognition’. There must surely be consensus around the fact that education is about becoming cognisant and that providing teachers with strategies that facilitate that process for their students must be a good thing. In presenting an imaginative response to changes within the rhythm of art and design teaching in English schools, I am seeking to problematise ‘cognition’ (as it is understood within the CCF and ECF) as a floating signifier and to propose alternative ways that coming to know in an art and design context may be imaginatively framed. In this I am drawing on wider cognitive science research within the field of neuroaesthetics. This demands some troubling of the application of cognitive science within the classroom as *always* requiring acts of imagination, before engaging in my own imagining from neuroscientific research, in relation to art and design.

The research by Perry *et al.* (2021a) sought to explore the evidence base for the cognitive science principles listed above. Their systematic survey rejected studies taking place in a ‘basic’ cognitive science context (in controlled conditions outside the classroom to generate understanding that may be broadly generalisable) and instead favoured those conducted in the applied context of the problems of everyday schooling. There is an implied direction of travel from the basic (which establishes a generalisable strategy) to the applied (which tests the strategy in the real-world context) to long-term practice. In their accompanying summary document, they point to a potential theory-to-practice divide and the danger that the potential power of cognitive science principles may be ‘lost in translation’ (or distorted, as described above) as they move from the basic science, to applied science, to long-term practice, through misunderstanding, a lack of training for teachers, ineffective targeting or simply because the principle does not work in that context (Perry *et al.* 2021b, p. 11).

In order for basic, or even applied cognitive science to have an impact on long term classroom practice it must be 'folded' into the real-world complexities of classroom practice (Atkinson 2017, p. 7). This complexity is something Deborah Youdell has referred to as the choreography of schooling (Youdell & Armstrong 2011)—a way to 'think about the flow of affectivities, bodies and meanings in education spaces' (ibid, p. 145). In other words, cognitive science does not arrive in the classroom through its own means but through the imaginative interpretation of those teachers who seek to implement its principles within the entangled relations and rhythms they find themselves in.

The isorhythms of art and design education

The CCF and the ECF, through their advocacy of cognitive science principles that rely on repetitive rehearsal of knowledge, can be seen as attempts, by those involved in their design, to standardise the choreography of teaching. The cognitive science model of mind (Figure 1) provides a choreographic map of what form that should take, leading to what Bruner referred to as a computational approach to learning. A computational understanding is, Bruner explains, 'concerned with *information processing*: how finite, coded, unambiguous information about the world is inscribed, sorted, stored, collated, retrieved and generally managed by a computational device' (1997, p. 1). By computational device, he means the student's mind which is tasked with producing outputs (learning) that closely match inputs (the information that they are instructed to learn). Bruner's problem with such a model is that it takes no account of culture, the context for learning which ensures that 'the process of knowing is often messier, (and) more fraught with ambiguity' (ibid. p. 2). Writing at a similar time to Bruner, Hutchins was also critical of computational understandings of cognition for assuming that knowledge resided in the mind of the individual rather than being a distributed practice across the interaction of the body with its tools and its environment (Hutchins 1995).

Unlike the standardised choreography of cognitive science, the notion of choreography provided by Youdell and Armstrong provides a way to think about learning within the messy, ambiguous, distributed context of the art and design classroom. Elsewhere (Wild 2022) I have discussed how each art and design classroom is not a generic background or stage upon which the act of teaching takes place but is instead a unique dance-like event formed by the complex repeating intra-actions of differing entanglements of people, materials, pedagogy, policy, curriculum and so on. Though each iteration of the art and design classroom is different, these returning oscillations (Thompson & Cook 2014) provide a familiar rhythm to all within the choreography of the school. Reporting on the findings of their research in 'arts rich schools', Thomson and Hall also speak of the unique atmosphere of art and design classrooms in terms evocative of returning choreography. They propose that art and design teaching has a unique 'isorhythm' (2021). An isorhythm refers to an established, enduring, complex repeating pattern within a musical composition. What interests me here is that, like the language of cognitive science, there is an emphasis on repetition, but it is of a very different kind.

A key concept in Thomson and Hall's discussion of the isorhythm of the art and design classroom in arts rich schools is that of affect which they define in terms of its etymology from the Latin *affectus*, 'to be acted on', by the energies 'that exist in the inbetweenness of human and non-human bodies' (2021, p. 601).

From Massumi they suggest that '(a)ffect is social, shared and beyond the human body, a relational human-non-human process always under way, in process' (ibid). This aligns with my own exploration of the art and design classroom as a rhythmic, affective space, (Wild 2022, p. 32) in which I draw on O'Sullivan's description of art being 'a place where one might encounter the affect' (2001, p. 26), through paying attention to the work-of-art and to use Massumi's words be 'swept up by it' (Massumi 2011, p. 3). As Thomson and Hall go onto explain, their observations of art and design lessons in school and interviews with art and design teachers and students, suggested that a key part to being 'swept up' by the rhythm of learning in art and design was that '(f)or the most part, art is an interrupted long duree, where students come in and out of the art room picking up what and where they left off' (2021, p. 609). This contrasts with other subjects where teaching is frequently broken down into a 'syncopated' rhythm of a three- or four-part lesson structure with lesson starters and plenaries. Thomson and Hall point to the sense of flow (Csikszentmihalyi 1998) that develops through the slower, less syncopated rhythm of the creative project and I would suggest that, additionally, it creates space for students to experience flow's coexistent other, that of 'hitting a wall', and having to negotiate one's way through, by employing strategies such as engaging with the unknown through play and experimentation, of trying things out again in a different way, using alternative media, or varying the composition. There is therefore a very strong element of returning or retrieving in art and design, whether that is learning how to pick up where you left off, or how to creatively improvise around a theme to find a way through. This kind of repetition is for a different end to simply or only remembering because an important aspect of learning in the subject involves, as Thomson and Hall suggest, a 'hold to open-ness rather than knowing an answer' (Thomson & Hall 2021, p. 609).

Willingham does not see student's creative work as having cognitive value beyond enjoyment, he would propose repetitive imitation of other's work and processes as more reliably leading to long-term remembering. Such mimetic processes do, of course, often have an important role to play within the progress of the creative project, however, the above description of the isorhythm of art and design suggests that more is required to be 'swept up' and affected by learning. As I go on to explore how research within the field of neuroaesthetics may animate the teaching of art and design, the cognitive significance of a 'hold to openness', through students' creative interpretation and practice will become clear.

Neuroaesthetics: A different kind of neuroeducation

Whilst government rhetoric is focused on neuroeducation to solve the complex problems inherent in teaching and learning, the cognitive scientists themselves are more circumspect (Ansari *et al.* 2012; Donoghue & Horvath 2017). Firstly, as I have already laid out, despite huge claims for the transferability of findings from cognitive science in the classroom, there are problems with the translation of generic basic science into specific subject areas and classroom contexts. Secondly, particularly in relation to the applicability of cognitive neuroscience to the classroom, research in the field has yet to offer anything new to classroom practice—it often simply tells us what we already know through the behavioural data of cognitive psychology (Ansari *et al.* 2012; Bowers 2016).

These twin criticisms do not necessarily negate the worth of engaging in neuroeducational research for art and design education. In what follows I argue that, taking an imaginative leap from a little-known area of cognitive science to pedagogy, that of neuroaesthetics, provides a way to resist the floating signifier of ‘what works’ in favour of an alternative—‘what animates’. In other words, what enlivens and sets in motion the already known isorhythms of art and design education.

Neuroaesthetics is a relatively new but growing area of research ‘concerned with understanding the biological bases of aesthetic experiences’ (Chatterjee & Vartanian 2014, p. 370). It involves the investigation of activity in the brain during aesthetic engagement—namely, encountering and learning through art works created by others and through engaging in art making processes that generate original artistic creations. Aesthetic perception is defined within neuroaesthetics as perceptual experience that is evaluative, affectively absorbing and involves sense-making (Chatterjee & Vartanian 2016; Pearce *et al.* 2016; Sacheli *et al.* 2022). Much neuroaesthetic study takes place within dementia and stroke recovery research, exploring the effects of neurological damage and disease on aesthetic perception, both in terms of heightened awareness (Miller *et al.* 1998; Miller & Hou 2004; Sherwood 2012) and potential decline (van Leeuwen *et al.* 2022).

I will briefly summarise three ideas that have grown out of neuroaesthetic research, the aesthetic triad, stopping for knowledge, and art as social cognition, before proposing how these might be imaginatively employed for pedagogic purposes within the art and design classroom. As I am writing for a readership of art and design educators, rather than cognitive scientists, my summary is descriptive of the principle rather than the minutiae of neuroscience itself.

The aesthetic triad

The aesthetic triad is a model for understanding aesthetic perception proposed by Chatterjee & Vartanian (2014). Reviewing several lab-based neuroaesthetic studies, they observed different neural networks at play in research participants engaged in aesthetic perception tasks, focusing particularly on individuals who had brain disease or injury. They concluded that because artistic awareness can be altered and improved during or following such conditions ‘the brain does not harbor a single art module’ (Chatterjee & Vartanian 2014, p. 373). Instead, they proposed that aesthetic experience is an ‘emergent state’ enacted by the flexible interaction of three areas of brain circuitry, the sensory–motor, emotion–valuation, and meaning–knowledge circuits. Importantly this means that art-related cognition is not a unitary phenomenon. There is memory retrieval required but for aesthetic learning to happen it must take place within the open and flexible perceptive, cognitive, and affective interaction of these complex neural systems in combination.

Stopping for knowledge

Neuroaesthetic research appears to affirm philosophical conceptions that encountering art works or engaging with creative practice is a way of escaping habitual, instrumentalised ways of being (Atkinson 2017; Biesta 2020; Wild 2022). Recent findings suggest that the complex interaction of the aesthetic triad engages inhibitory mechanisms in the brain. These prompt a pause in activity to focus fully on the uncertainty or cognitive dissonance caused by visual, material, auditory stimuli that present a challenge to habitual ways of being in and understanding the world (Sarasso *et al.* 2020; Sacheli *et al.* 2022). A foundational idea is that of

disinterestedness (first explored by Kant in *Critique of Judgement*), otherwise described as engaging with an object on its own terms, for its 'own sake', for its own innate reward, rather than for pre-determined, exterior, instrumentalised or 'interested' outcomes. As Sarasso *et al.* note, this echoes Dewey's notion that aesthetic experience causes the individual to pause, to be in the moment, here and now, released from 'mechanical' ways of being in the world (2020, p. 725). This is what gives art its therapeutic power. They go on to explain that the heightened perceptual awareness, identifiable through neuroimaging, that occurs during aesthetic experience contrasts with the perceptual depletion or filtering that occurs in response to one's habitual movement in the world. They hypothesise that the intensified sensory perception that is occasioned by being stopped by something unpredictable and out-of-the-ordinary, for example something exceptionally beautiful or awe-inspiring, employs the aesthetic triad to work towards re-establishing predictability, leading to aesthetic pleasure. To state it in their own words, 'aesthetic appreciation involves a relief of uncertainty following an act of exploration prompted by curiosity' (*ibid.*, p. 731). This, they suggest, explains our changing aesthetic preferences over time. As particular art works or practices become well-known to us, they become predictable, and cease to 'trigger perceptual learning, which in turns would induce aesthetic appreciation' (*ibid.*). We are then prompted to look again from a different perspective or to apply a new process or technique to find aesthetic pleasure.

Building on the above work on 'stopping for knowledge' Sacheli *et al.* (2022) report that one outcome of repeated engagement with aesthetic experiences is an increased tolerance of unpredictability. They speculate that this tolerance of uncertainty allows for ever more complex and sophisticated understanding and creation. Such an understanding of the effect of engaging in art making and appreciation connects back to Thomson and Hall's observation that art and design pedagogy involves a 'hold to openness', to being affected by ongoing exposure to artists, objects, materials, and processes that might surprise and stimulate one's perceptual capacities and lead to learning (Thomson & Hall 2021). This returns me to Willingham's views regarding the cognitive value to students of engaging in creative work. His denigration of the value of creative composition as simply one of enjoyment overlooks the fundamental role that such acts play in developing tolerance for uncertainty—the very 'cognitive equipment' required to eventually practice as an expert in subjects such as Art and Design.

Art as social cognition

Recent research by van Leeuwen *et al.* (2022) has overlaid aesthetic experience onto the social brain connectome created by Alcalá-López *et al.* (2018). This is a 'Social Brain Atlas' created by synthesising data garnered from scanning the brains off 22,712 neurologically healthy adults. Simply put, this mapping sought to visualise the complex brain activity of engaging in social interaction. In comparing brain scans of participants engaged in aesthetic activity with the Social Brain Atlas, van Leeuwen and colleagues discovered that there are parallels in brain activity between encountering an artwork and encountering another person. They identified four different neural networks that are simultaneously in action when experiencing a work of art. These they refer to as the perception network, the animation network, the interaction network, and the construction network. They proposed that the work the perceptual network does in the analysis of relations between elements of an artwork is analogous to surveying the intricacies of social

environments. This process of formal analysis is not passive, however, but engages the animating network in dynamic sensory processing, which animates, or enlivens one's senses causing an aspect of the world to come alive to us in a new way, generating new perspectives or ways of relating. Their suggestion that this animating process is necessary for our 'aesthetic sense' echoes Eliot Eisner's discussion of the heightened feeling of the aesthetic, as being best understood by its opposite, *anaesthetic*—which suppresses and dulls the senses (Eisner 2017, p. 81). Mirroring social interaction, this active engagement with an artwork, also draws on the interaction network, utilising the individual's 'stored habitual norms' collected through previous encounters with artworks in combination with their current inward and outward priorities (which could include physiological needs such as hunger, and emotional states such as stress). Finally, the Construction Network is simultaneously employed in interpreting the work of art to form symbolic and personal meaning, through imagining a mental model of the artist's intentions in combination with their own experiences. Stating that an 'individual's personal engagement with and appreciation of the "meaning" of an artwork are likely to depend on a complex and dynamic interplay of the four networks' they point to deep engagement with the artwork as successfully generating an 'integrated response' (van Leeuwen *et al.* 2022, p. 12).

In an example of pedagogy speaking back to brain science, van Leeuwen's recent work reports on research that used Housen and Yenawine's Visual Thinking Strategies (VTS) model, originally developed at the Museum of Modern Art, New York, to explore art and the social brain in action (van Leeuwen 2023). VTS uses three questions (What's going on in this picture? What do you see that makes you say that? What more can you find?) to facilitate analysis and interpretation of an artwork through individual and group discussion. With her colleagues, van Leeuwen found that participants who were supported to respond to artworks using an adaptation of VTS were able to maintain their attention on the work far longer than those who were provided with only contextual information—thus both increasing their tolerance for uncertainty and generating an integrated response. As van Leeuwen acknowledges, the superior ability of VTS to enhance visual attention for social cues provides empirical support for the core premise of social constructivism that learning and cognitive development take place in a social context and depend fundamentally on interactions with others. One of her key references is Jerome Bruner who, as discussed above, suggested that both computational and cultural learning processes are necessary in the classroom. He contrasted the remembering or forgetting outcome of computational processes with the ability or inability to form a coherent narrative of learning from cultural processes. This is akin to the integrated response as explored by van Leeuwen and colleagues.

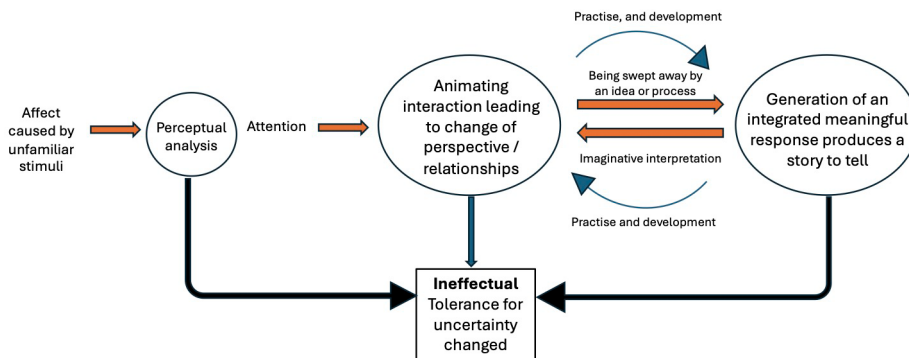
Conclusion

Neuroaesthetic research is in its infancy and its findings should therefore be approached cautiously (Sacheli *et al.* 2022). Studies on aesthetic perception tend to use little-known artworks (that are almost always figurative in nature) and use amateur (rather than expert) participants. Studies on the creation of artworks also rely on amateur participants and do not involve 'artmaking' as most artists would recognise it. In both cases they take place in laboratory conditions rather than in the 'real world' context of artist studios, workshops, or classrooms. However, from

these limited beginnings, the findings reported above are consistent with what is known about art and cognition from the qualitative traditions of art and design education research which point to the isorhythm of learning in art and design as having a complex choreography. It is arguable that the aesthetic triad, the idea of stopping for knowledge and the idea of art as social cognition do not provide any new insights about cognition, as it is understood within the arts. They do provide a 'scientific' defence of the known isorhythms of art and design education as observed by Thomson and Hall, the importance of engagement with works of art and arts practices, not as instrumentalised objects, but as prompts to curiosity, the importance of a hold to openness and the significance of the flow of the long *durée* that is occasioned through being in the moment with aesthetic experience. These provide the inspiration in Figure 2 for my re-imagining of the illustration (Figure 1) provided at the beginning of this paper.

In Figure 2, the beginning is not something to be remembered but something to be enlivened. This could be an existing artwork or something in the world (an object, material, or process) to be drawn into the making of a work of art. Perceptual analysis (which could take place individually through drawing, photographing, writing, etc. or collaboratively in group discussion or critique) engages students in attentive practices that animate and enliven the phenomena in question, producing new perspectives and new relations. Through ongoing practice and development students are facilitated in being 'swept away' (Massumi 2011) by an idea or repetitive process of making to produce their own creative response, and simultaneously evolve their own imaginative interpretation of the work's significance or meaning for themselves. A successful encounter will result in students generating a credible integration of these two processes enabling them to tell a convincing narrative about their creative journey. If the encounter is unsuccessful, it will be ineffectual, not only because any potential learning has been forgotten but, more significantly, because the 'hold to openness' has not been sustained and the student's tolerance for uncertainty has not been increased.

So, to conclude, though understandings of cognitive processes that come to the art and design classroom from basic and applied cognitive psychology can offer useful generic understandings of teaching and learning, from the field of



A model of mind for the isorhythms of cognition in art and design

Figure 2

A Model of Mind for the Isorhythms of Cognition in Art and Design.

neuroaesthetics it is possible to imagine alternative ways of conceiving learning through art and design that perhaps affirm the complexities of art and design pedagogies that have formed the established isorhythm of the art and design classroom over time. This alternative choreography of learning is not predicated on a desire to know what works but is prompted instead by the question of what animates and enlivens the world for teachers and their students.

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Carol works at the Institute of Education, University College London where she is Subject Lead for the Art and Design PGCE course, teaches on the MA Art, Education, Culture and Practice and supervises PhD students. She previously led the MA Arts and Education Practices and the Artist Teacher Scheme at Birmingham School of Art, BCU. Carol’s research interests are motivated by a long-term interest in the symbiotic relationship between the art and design teacher, their classroom, and their pedagogy, that come into being together with their students. She is interested in ethnographic, site responsive, arts-led methods of researching in the art and design classroom as an affective space.

Endnote

1. Post-graduate Certificate of Education.
This qualifies an individual to teach in the United Kingdom.

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