http://doi.org/10.30827/reugra.v26i0.124

EXPLORING SPACE-TIME METAPHORS FOR CODING PRIMARY LANGUAGES

EXPLORACIÓN DE METÁFORAS ESPACIO-TEMPORALES PARA LA CODIFICACIÓN DE IDIOMAS APRENDIDOS EN LAS ESCUELAS PRIMÁRIAS

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Proceso editorial
Recibido: 06/11/2019
Aceptado: 08/04/2019
Publicado: 28/12/2019
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CÓMO CITAR ESTE TRABAJO | HOW TO CITE THIS PAPER

Phillips, M. (2019). Exploring Space-Time Metaphors for Coding Primary Languages. *Revista de Educación de la Universidad de Granada, 26:* 183-203.

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Abstract

Actions accompanying spoken language support its retention and recall. This strategy may be harnessed for learning additional languages in primary school (PL). Associated codes enacted alongside spoken language harnesses the brain's mirror system, enabling recall whenever the associated action is re-enacted, no matter by whom. Reliance on the orthographic form is potentially deleterious when establishing pronunciation. 'Embodied cognition' hypothesises that all input is represented within sensory and motor systems in learners' conceptual processing (Mahon & Caramazza 2008), However, the disembodied cognition hypothesis questions the processing through these systems of abstract or symbolic concepts because of their different qualitative nature. Temporality is arguably an abstract concept because it is relative and unidentifiable within any particular sensory system. However, the space-time metaphors we conceptualise within the space around ourselves may be schematised to represent past, present and future, Indicating them within associated codes might extend pupils' spoken repertoire and grammatical insights of tense.

Restricting PL learning to the simple present form limits language functionality and therefore its authentic use, including for bilingual or CLIL approaches. Explicitly learned PL grammar is challenging for early stages of cognitive development. However, aptitude for language phonology, said to peak aged 4, enables pupils to learn verb tenses in spoken form. In England, pupils (aged 6 – 7) conceptualise notions of present, past and future within English (National Curriculum 2014), and also past progressive L1 verb tenses. Support from associated codes enacted alongside rehearsed PL spoken forms would enable recall and retention.

This paper is a systematic literature review exploring space-time metaphors which harness body space as a code for temporality. The following section provides a brief overview of primary languages learning in England, in contrast to other European countries.

Keywords: space-time metaphors; coding verb tenses; inclusivity

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Resumen

Las acciones que acompañan al lenguaje hablado apoyan su retención y recuerdo. Esta estrategia puede aprovecharse para aprender idiomas adicionales en la escuela primaria (PL). Los códigos asociados promulgados junto con el lenguaje hablado utilizan el sistema de espejo del cerebro, lo que permite recordar cada vez que se vuelve a representar la acción asociada, sin importar quién lo haga. La dependencia de la forma ortográfica es potencialmente perjudicial al establecer la pronunciación. La "cognición corporal" hipotetiza que todo el input se representa dentro de los sistemas sensoriales y motores en el procesamiento conceptual de los alumnos (Mahon y Caramazza 2008), Sin embargo, la hipótesis de la cognición desencarnada cuestiona el procesamiento a través de estos sistemas de conceptos abstractos o simbólicos debido a su diferente naturaleza cualitativa. Se puede decir que la temporalidad

es un concepto abstracto porque es relativa e inidentificable dentro de cualquier sistema sensorial particular. Sin embargo, las metáforas espacio-temporales que conceptualizamos en el espacio que nos rodea pueden esquematizarse para representar el pasado, el presente y el futuro. Indicarlas dentro de los códigos asociados puede extender el repertorio hablado de los alumnos y los entendimientos gramaticales de tiempo.

Restringir el aprendizaje PL a la forma presente simple limita la funcionalidad del lenguaje y, por lo tanto, su uso auténtico, incluso para los enfoques bilingües o CLIL. La gramática PL aprendida explícitamente es un desafío para las primeras etapas del desarrollo cognitivo. Sin embargo, la aptitud para la fonología del lenguaje, que se dice que alcanza a un máximo de 4 años de edad, permite a los alumnos aprender los tiempos verbales en forma hablada. En Inglaterra, los alumnos (de 6 a 7 años) conceptualizan en inglés las nociones de presente, pasado y futuro (National Curriculum 2014) y también los tiempos verbales progresivos de L1. El soporte de los códigos asociados actuados junto con los formularios hablados de PL ensayados permitiría la recuperación y la retención.

Este artículo es una revisión sistemática de la literatura que explora metáforas espacio-temporales que aprovechan el espacio corporal como un código para la temporalidad. La siguiente sección proporciona una breve descripción del aprendizaje de idiomas primarios en Inglaterra, a diferencia de lo de otros países europeos.

Palabras clave: metáforas espacio-tiempo; codificación de tiempos verbales; inclusividad

EARLY PRIMARY LANGUAGE LEARNING IN EUROPE: GENERAL ISSUES

Recognition of young learners' aptitudes for language acquisition (Lenneberg 1967) propelled a pilot scheme in England for pupils to start learning French in primary, rather than secondary, school (Burstall 1968). Despite the scheme's eventual demise (Burstall 1974), some other European countries set up their own primary languages (PL) programmes (Blondin et al. 1998). In England and Wales, however, PL learning became statutory relatively recently (DoE 2014). While PL learning is officially underway (Language Trends Survey 15-16: 2018), its practice is yet to be categorically inspected. Trainee teachers commonly report little or no PL practice seen during school-based practice, due to timetable pressures on core subjects, assessments of which contribute to schools' published rating. Thus, although officially statutory in the curriculum, the status of PL remains low among primary school curricular subjects.

Variations across Europe's PL learning practices are due to multiple factors, three of which are overviewed here. Importantly, children's exposure to PL phonology influences their processing and spoken production (Pizorn 2017). For native English-speaking countries, the dilemma of which PL to target, contrasts with countries where English is not the first language (L1). Spoken English, the current lingua fran-

ca for world trade, is widely accessible in the media. For native English-speaking children, exposure to the phonology of other languages is negligible. Surprisingly, there is little discourse on the significance of this lack of exposure, or how it might be compensated for within PL practice.

A second factor, children's heightened language sensitivity, which propelled the PL initiatives in Europe, is rarely specified by policymakers in England (DoE 2014). Despite children's sensitivity to language *phonology*, rather than orthography (Schumann 1998), much primary school learning is still evidenced in paper form and therefore involves initial reading/writing. Generalist primary teachers may lack confidence in their PL skills, and fall back on the secondary school methods they had previously learned, using translation and vocabulary lists. Possibly ignorant of their pupils' phonological sensitivity, they may introduce language in orthographical form. Teacher expertise and the nature of provision have been shown to influence learner outcomes (Murphy 2014). Despite neurobiological indications of children's aptitudes, government PL policy does not reflect them.

Thirdly, in England and Wales, negligible exposure to spoken PL form may results in its memorisation through orthographical forms. While easily accessed at any time from paper or screen, orthographical forms require decoding, the accessing of L+ sounds from its graphemes. Learning phonics is a process which cannot be unlearned, Blakemore and Frith (2005) liken it to 'brainwashing' while Dehaene et al. 2010) claim its effect on cortical reorganisation. The resulting risk of interference between the differing L1 and PL phonics rule may be considerable, especially where the L1 and PL employ the *same* alphabetic code. Importantly, incorrect decoding tends to result in poor pronunciation which, in turn, affects comprehension detrimentally (Ahangari et al. 2015: 13) and thus the ability to communicate effectively in the L+.

'Solid literacy skills underpin all academic achievement.' (Murphy 2017: 47). The study 'Progress and Preparedness for Secondary School' conceptualised PL learning outcomes within three factors: pupils' underlying knowledge of grammar; vocabulary; 'readiness for secondary school' (Graham 2012). With no explicit learning of French phonics, pupils thought writing was the most boring activity. Given young learners' cognitive development, and the lack of curricular time currently allotted for PL learning in England, a literacy-focused approach risks insufficient harness of learners' temporarily heightened sensitivity to phonology (Schumann 1998). Mispronunciation resulting from L1 phonics interference may be exacerbated by non-specialist teachers' poor modelling. Teacher trainees' self-efficacy study (Phillips 2012) demonstrated the significance of pronunciation to their levels of confidence

for delivering PL. The question arises, therefore, as to *when* literacy skills should be introduced in relation to oracy skills.

A clearer sense is needed of progression through the development of different language skills. 'Vocabulary (oral language) is a very strong predictor of literacy development' (Murphy 2017: 58). Should oral language therefore precede literacy skills? Written forms are codes of the generic spoken form; while they may support memorisation, particularly for adults, they invite potential building of bad habits through applying L1 phonics. Translation occurs especially for English cognates.

Additionally, primary school classrooms enjoy a diversity of pupils, amongst whom, special educational needs (SEN) children are frequently categorised by their literacy skills.

> ...low mean scores illustrated that there were aspects of language learning that most children in the sample found challenging, for example, converting print to sound. (Porter 2017: 80).

Putting orthographical forms as the main mental concepts of PL learning may thus discriminate heavily against the inclusion of SEN pupils.

Beyond successfully converting print to sound, pupils need to associate meanings. Where English meanings are supplied alongside the PL words, a habit of translation is learned. A later section refers to usage-based linguistics theory which suggests the importance of context for accessing meaning.

The currently eclectic approach to PL practice in England overlooks many of the issues overviewed here. Findings from cognitive science provide invaluable insights into the brain's processing of experience and information.

> Only by understanding how the brain acquires and lays down information and skills will we be able to reach the limits of its capacity to learn. (Blakemore and Frith, 2005)

The next section looks at the potential of innate skills for inclusive and time-efficient practice and learning.

LEARNING LANGUAGE USING INNATE SKILLS

The evolution of the human brain over millions of years has equipped it with innate skills (assuming no physical impediment), including the processing of signed movements, likely used for communication before the development of language (Wray 2002). By contrast, 'Reading, not to mention writing and texting, is a relatively recent

invention' (Dehaene et al. 2010). Deployment of innate processes, using alternative representations of language, potentially supports effective learning of phonology; Orthographic forms necessitate decoding graphemes, a process which takes several years to learn, and which is influenced by L1 phonics. Alternative PL representations may support PL learning (Porter 2012), using associated codes with spoken forms (Phillips 2010). Signs and symbols used in 'Talk for Writing' (Palmer & Corbett 2003; Corbett & Strong 2011) are increasingly adopted for the early learning of L1 writing in schools in England and Wales. Daily practice in key stage 1 (pupils aged 4 – 6) capitalises on children's heightened phonological sensitivity, their innate skills thus preceding the introduction of the written form. Spoken full sentences are coded into actions and then symbolised in drawings as an aide-memoire for writing them up. Oral skills thus precede eventual writing.

Spoken forms are recalled through reenactment of an action associated with them due to the brain's mirror neuron system (Giese & Rizzolatti 2015). This enables a teacher to successfully prompt pupils' recall with solely an action (Phillips 2010) learned simultaneously with the spoken form. Iverson and Goldin Meadow (2005) studied infant use of gesture and their subsequent language progress, including writing. 'Gesture paves the way for language development' (op. cit.).

> Teaching a new concept through gestures—hand movements that accompany speech— facilitates learning above-and-beyond instruction through speech alone… (Wakefield et al. 2018).

This suggests possible further cognitive benefit for adopting associated codes in PL learning. It also endorses that it precede literacy skills.

Pointing is in itself an indicator of infant social development; 'finger pointing … provides support for social-pragmatic approaches to communicative development' (Cameron-Faulkner et al. 2015: 576). 'Before . . [2.5 years of age], children often combine their nouns with gestures that indicate the object labeled by the noun,' (Cartmill 2014:1660). These are examples of deictic pointing, an innate part of semantic communication, which can occur even pre-speech. For pupils learning PL, albeit no longer infants, pointing indicates both their own comprehension and their social communication. Because deictic pointing requires the presence of the object alluded to, it can indicate common nouns or single units of meaning easily. Because PL practice schemes of work may be 'too noun based' (Macaro 2003: 201), PL might be learned for meaningful communication in functional sentences. This would involve learning verbs, arguably the greatest predictors of meaning in any sentence. A system of gestures is therefore required to incorporate different verb forms as temporal parameters within young learners' PL communication. Strategies for cap-

turing these concepts may call upon two further classifications of gestured codes, namely iconic and metaphoric forms (Goldin-Meadow 2003: 7: Goldin-Meadow & Singer 2003).

ICONIC AND METAPHORIC GESTURES

Iconic gestures are representative of the qualities of the item or experience which is being referred to. 'Iconic gestures helped [foreign language] learners to significantly better retain the verbal material over time' (Macedonia et al. 2011). 'Memory performance for newly learned words is not driven by the motor component as such, but by the motor image that matches an underlying representation of the word's semantics'. (op.cit.: 982). In memorising new language, then, the *representations,* rather than actual enacting, of movements, are the mental concepts of language that are stored.

Metaphors are representative or symbolic of something else. Metaphors may thus represent sounds themselves. Each syllable of a sound and/or its prosody, may be coded specifically for PL learning (Phillips 2010). 'Associative codes' (ACs), for example, for weekdays, may emphasise numbers of syllables (op.cit.), and reflect the affective qualities of each day. Elation for 'samedi', for example, mimics pupils' feelings on that (weekend) day off school. Days are named after planets and gods but for a native English-speaking child, the French forms have little associative link to English forms.

Importantly, the teacher's language-role modelling using associated codes requires mastery through 'little and often' practice, as with any form of procedural learning.

> procedural memory is more robust [than declarative memory] so that, once formed, it is better preserved. (Lee, (2004: 69)

The danger of this preservation is that language may become 'fossilised':

> Influences from procedural memory are greater than those from declarative memory, resulting in the production of a fossilized phrase (Schuchert, 2004: 169)

To avoid such fossilisation, phrases require further manipulation. Therefore teachers need to recognise learners' needs and progress, setting next steps appropriately. For example, verb forms may be deployed in different tenses in full sentences, avoiding the risk of fossilisation,. Using gestured associated codes, pupils as young as six can manipulate different verb tenses in sentences (Phillips 2010). This suggests a metaphorical system to represent temporality.

The next section provides an overview firstly, of language learning theories which describe the process of L1 acquisition through innate aptitudes. Increasing recognition of embodied cognition then is explored to explain learning generally, and particularly of language. Applied to PL learning, reinforcement occurs through metaphorical actions accompanying spoken language.

USAGE-BASED LINGUISTICS IN EARLY LEARNING

Contemporary developmental psychologists regard two sets of skills as paramount in language acquisition, namely intention-reading and pattern-finding (Tomasello 2003). The theory of usage-based, or cognitive functional, linguistics (op.cit.) holds that language is the symbolic mapping of experienced events. (Grammar is a derivative of applying the sounds to experienced contexts.) Children understand spoken L1 language through experiencing ever changing contexts, thus mapping language onto those contexts. Any item/object local to the learning environment is easily indicated deictically or portrayed through transmissive technology. In school classrooms, which are potentially arid contextual environments, Iconic or metaphoric associated codes may be needed to indicate further contexts and intentions.

Applying this theory to PL learning implies provision of opportunities for pupils' speaking and listening in experienced contexts. In the case of verbs, in order to support pupils' use of different tenses, a system of reference is needed by which to refer to the temporal aspects of verb forms.

The next section draws on embodied cognition hypothesis that learning involves mental concepts internalised through the body's senses.

LEARNING AS MENTAL CONCEPTS: EMBODIED COGNITION

Enacted associative codes lie within the paradigm of embodied cognition.

> The embodiment hypothesis is the idea that intelligence emerges in the interaction of an agent with an environment and as a result of sensorimotor activity.(Smith & Gasser 2005: 13).

Such associated codes constitute sensorimotor activity. Through use of deictic, iconic and metaphoric pointers, they may conjure imagined nouns and non-present phenomena. Space-time metaphors exploited to indicate temporality provide a context and involve sensorimotor activity.

So-called Hebbian learning principles suggest (Pulvermüller et al., 2006) that 'action-perception links' (Adams 2016) in the brain are strengthened by using a language's phonological forms (thus necessarily speaking and hearing them) while in the process of enacting a verb. To exploit this cognitive characteristic, internalised sensorimotor experiences may constitute the mental concepts of pupils' learning, advancing their intention-reading and pattern-finding skills within spoken PL.

Questions arise as to the effect on on later learning of reliance on these sensorimotor mental concepts, and how such learning may be assessed. In England and Wales, teachers' practice may be inspected by The Office for Standards in Education, Children's Services and Skills (Ofsted), a non-ministerial governmental department. Furthermore, the current National Curriculum (DfE 2014) and a previous governmental framework (DfES 2007) for key stage 2 PL learning make no reference to progression from oracy to literacy skills. Indeed, the permanence of orthographic, over ephemeral spoken forms may provide a mnemonic device for less confident pupils and teachers. 'Learning styles' (Gardner 1993) is a theory currently largely accepted in higher education institutions, despite lack of neurobiological evidence to support it, and Gardner's own revision of the premise (2008). Embodied cognition alludes to a variety of learning experiences: firstly, the human sensorimotor activity interfaces through the senses, with an environment. This establishes initial brain pathways that favour that form of interface. The brain continues to seek it out, a characteristic of brain plasticity, briefly described in a later section.

Introduction of orthographic with spoken forms influences the nature of PL pupils' initial mental concepts due to:

1. the potential interference of a previously learned phonics system
2. the impact of the *initial* apprehension of language items due to brain plasticity (Ostry & Gribble 2016).
3. Inexpert class teachers' possible resort to orthography may threaten pupils' pronunciation and lacks affective impact (Schumann, 1998; Arnold, 1999; Young 1999).
4. written work necessitates paper management, arguably overly time-consuming given limited curricular time

Language learning avoiding orthographical forms may employ symbol-mediated codes to accompany spoken language. Building teachers' capacity for adopting such an approach necessitates their recognition of the senses involved, its stprage as mental concepts and how to move them on. According to the hypothesis of embodied cognition, "the so-called 'motor functions" of the nervous system not only provide the means to control and execute action but also to represent it" (Gallese 2000: 23). Motor actions are thus not only the mental concepts constituting the actual learning,

but also the representations of it. The implicit potential for sensorimotor associated codes is considerable, firstly, to enhance language learning, using innate affordances of the brain. Secondly, sounds and associated actions constitute the means of learning and also, its mental representations. Images or symbols can be further manipulated by pupils, once associated codes are successfully established. Embodied cognition suggests that initial learning internalises mental concepts through the body senses which are subsequently available for the learner's active usage.

Some of the characteristics of brain plasticity are discussed next.

BRAIN PLASTICITY

Brain plasticity is the forging of brain 'pathways' according to the activity undertaken, and the mental concepts involved. Its very architecture is thus built according to those conceptualisations and their manipulation in the brain (Schumann et al. 2014). Brain structure is constantly modified by the activities that it undertakes, from before birth right through life (Mechelli et al. 2004: Lövdén et al. 2013), assuming the brain remains healthy.

However, pupils' heightened sensitivity to L1 phonology peaks at the age of four:

> Evolution has designed the brain to acquire grammar and phonology by about four years of age through natural interaction with others. Some margin of heightened adaptability probably extends this learning period to the middle of the second decade of life. Once that period has passed, the brain can be viewed as 'damaged' with respect to the skill to be acquired. (Schumann 1998: 38)

This has significance for teachers, who, as adults, no longer enjoy this heightened sensitivity to phonology of their young pupils.

> genuine naturalistic interaction,... is the experience the neural system expects and requires in order to learn under the heightened plasticity of the sensitive period (Schumann 1999: 40).

However, teachers may still learn the skills required:

> The human brain has the remarkable capacity to alter in response to environmental demands. Training-induced structural brain changes have been demonstrated in the healthy adult human brain. (Hyde et al. 2009: 3019).

Educational literature largely encourages new approaches to learning, but usually ignores the implications of brain plasticity. Belief systems influence practice and research designs. Research studies remain largely grounded and based on 'the systematic discovery of theory from data' (Robson 2002: 548). For example:

> ...the CLIL group outperformed the non-CLIL group in reading/writing, but not in listening comprehension skills. One of the most likely reasons for such results might be the increased input of authentic reading texts and tasks the students had to read and complete. (Porter, 2017: 160).

The improvement of skills through practice is central to procedural learning. Brain plasticity advises that any predilection for skills established through practice and learning becomes difficult to change, This places a significant onus on teachers to establish good habits for their pupils' subsequent learning.

Temporality: using verbs

Appealing to the body's natural motor systems and references is said to affect the learner's emotional reponses.

> Emotions emerge as specific forms of a subject's bodily directedness toward the valences and affective affordances of a given situation (Fuchs & Koch 2014).

Bodily directedness toward the conceptualisation of time requires a designed code situatedness within timeframes.

> Everyday concepts of duration, of sequence, and of past, present and future are fundamental to how humans make sense of experience (Nuñez & Cooperrider 2013: 220).

Having established perspectives from both language learning theory and cognitive science, this section discusses the use of coded actions to support time references within verb tenses.

> Verbs represent a categorization of events. Events do not come clearly individuated in space or time (the latter dimension being relevant for events but much less so for objects). (Croft 2014: 58).

In England, pupils are introduced to temporality in Year 2 (aged 5-6) in English learning, recognising simple past, present and future forms. Irregular past forms are also practised verbally. Thus they conceptualise the relativity inherent within the passage

of time in the L1. With 'little and often' practice, PL verb inflections in functional sentences can be effectively learned as 'language vehicles', songs specifically designed to include targeted functional language, and associated codes (Phillips 2010) representing the verb tense inflections.

This involves systematising space-time metaphors within gestural repertoires by looking at 'how linguistic symbols become meaningful through grounding in perception, action, and emotional systems' (Glenberg & Gallese 2012: 905) with regard to temporal indicators. The next brief section explores the interrelations of simple and continuous verb forms.

Simple and continuous verb forms: a brief overview

In English, simple verbs consist of one word in past and present, while the future form incorporates the auxiliary 'will' in addition. Pupils' explicit knowledge of L1 tenses increases from year 2 onwards, starting with recognition of simple present, past and future forms.

Simple forms are functionally limited in everyday usage; this suggests progression to continuous forms. Simple and continuous verb forms exist in English and Spanish. In PL learning in England, the surge of uptake of Spanish, and decline of French (Language Trends 2018) recommends Spanish as a relevant example to explore enacted space-time metaphors.

Simple and continuous forms are relativistic. Teachers modelling them need to know their differing functions within the particular targeted PL language. In Spanish, simple and continuous forms may prove easier to conceptualise due to their similarity with English. Enacted representations of temporality must therefore reflect their usage within different languages' grammar.

Looking more closely at simple and continuous verbs, atelic verbs show that an action is incomplete, as with continuous forms. Telic verbs, on the other hand, show that the goal indicated by the verb is complete, usually represented in simple forms. Continuous forms denote unfinished actions which are temporary; simple forms denote brief and completed actions. To distinguish between atelic and telic verbs in associative codes, existing space-time metaphors are discussed.

SPACE-TIME METAPHORS

Humans naturally conceptualise temporality within the space surrounding them; 'concept retrieval is the reactivation of experiences stored in the sensory–motor cortices' (Bedney et al. 2008: 11347). This section explores how time may be metaphorically perceived in relation to body space. '... converging evidence that people use spatial metaphors in temporal reasoning' (Gentner et al. 2010) suggests harnessing these metaphors to construct associated codes for supporting PL learning of verb tenses. In English, idiomatic expressions often employ spatial metaphors to represent time. Amongst these are:

> She has a whole future ahead of her.
> Looking back on past mistakes,...

The next section describes spatial planes for potential representations of time within simple and continuous tenses.

The sagittal, frontal and transversal planes

Space-time metaphors potentially use three planes around the human body. The sagittal plane goes from back to front and may represent *sequential* time:

'Participants made temporal judgments about deictic or sequential relationships presented *auditorily* along a body-centered sagittal or transversal axis.' (Walker et al. 2014).

Interestingly, negative and positive attributes produce different directionality in the sagittal plane: '... positive and negative events are associated with different spatial metaphors of time.' (Margolies & Crawford 2008: 1401). This discussion restricts itself to positive events.

The frontal plane (cf. figure 1) may represent time in right to left, or left to right sequence.

> Duration is the second major temporal dimension open to gestural expression. The spatial construal of temporal distance is visually explicit: a "span" or "stretch of time" is measured by allowing the dominant hand to travel from left to right (or in front of oneself) between invisible time limits (CALBRIS 1990, p. 90). (Lapaire 2017: 4)

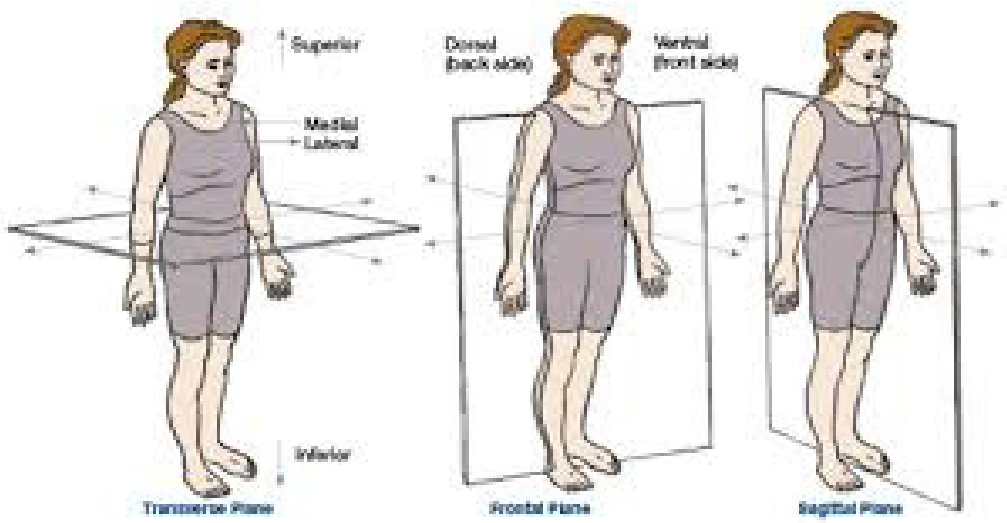

Figure 1. Three spatial planes of reference for space-time metaphors

Sagittal and frontal planes may therefore represent sequential time, and spans of time, respectively, distinguishing simple from continuous forms. Gestures devised to indicate the distinct temporalities, may exploit these two planes, combined with iconic represention alluding to the activity of the verb (for example, take, eat, finish), while imitating its phonological prosody and syllabic properties.

Temporal references: cultural influence

Differing cultural factors may influence learners' conceptualisation of coded temporality. Zinken (2010) considers that a 'systematic linguistic anthropology of time is less developed than one might expect (Levinson 2004)'. Whether universal body-space values are shared by languages or not, events are perceived within spatial reference, exemplified in the previous section. Thus conventionally, the future lies ahead of us, and the past behind us on the sagittal plane, taken from the (English) observer's point of view. Associative gestured codes that incorporate indicators ahead or behind, or to the position of the speaker may thus refer to future, past or present perceptions of time, respectively.

A 'space-time mapping' (Duffy 2014) that does not match the direction of orthography in native language (Fuhrman and Boroditsky 2010) may interfere with learners' conceptualisation of time. A study with sighted and blind participants concludes

that the 'same hoizontal mental time line' was used by blind and sighted alike but that each group were not relying on the same mechanisms' (Bottini et al. 2015: 71). However, the study's design allowed distinction only between mapping time as contrasted with number, and fails to identify the mechanisms involved. Western left to right reading (Santiago et al. 2007) contrasts with reading from right to left (Arabic and Hebrew), and Mandarin (from the bottom upwards on each vertical line). Regarding the flexibility of such learners to adapt to different schema (Torraibo et al. 2006) with directionalities of reading, Henricks & Boroditsks (2017) found that when new time metaphors were actively presented, adult learners were able to adopt them and even use them productively, despite their contradicting the left-right time metaphors inculcated from years of reading directionality. Adults' adoption of new schema independent of previous cultural influence suggests the potentiation of space-time metaphors for younger learners also.

ADDING A PEDAGOGICAL BACKDROP

An enduring challenge for teachers modelling embodied skills to pupils is that when face-to-face, the teacher's right to left movements appear to the pupils as left to right. To overcome this, facing the same way as pupils denies the teacher sight, and monitoring of the pupils. Lateral reversal of actions to elicit the required pupils' actions requires teachers' rehearsal for correct modelling. Even then, the desired imitation may still not be achieved. In two studies in which respondents had to judge a situation involving objects and a person near those objects, it was found that

> The implication of action elicits spontaneous spatial perspective-taking, seemingly in the service of understanding the other's actions (Tversky & Martin Hard 2008: 124).

There is potential, then, for observers to adopt either egocentric or allocentric perspectives, confusing the metaphorical intention of language. This puts greater onus on the semantic transparency of the gestured code when mirrored to pupils.

Teacher visibility should be taken into account in schematising space-time metaphors. Realistically, normal primary classrooms assume sighted pupils mostly seated, with only the teacher's upper half of the body reliably visible. However, this restricted view still allows sagittal and frontal planes within the temporal schema. Blind children may rely on "autotopological (or personal) deixis'; without sensorimotor experience, the processing of abstract concepts varies and the body is used as a reference frame (Iossifova & Marmolejo-Ramos 2013). Haptic gestures (using the sense of touch in the gesture) may constitute the frame of reference in this case.

CONCLUSION

This paper has conjectured the need and potential for alternative codes to represent temporality. The need responds to the paucity of exposure to spoken PL experienced in England, and the potential harm to pupils' pronunciation (and therefore comprehension) of relying on orthographic forms as the primary mental learning concept. Extensive recent research on embodied cognition and the space-time metaphors evident in language, propel a systematic review of findings from cognitive science studies and the human inclination for space-time metaphors to support PL learning context in England.

Pupils' transient heightened aptitude to language *phonology* recommends its essential harnessing for PL learning. Gestured associated codes for inclusive PL learning, used systematically to support telic and atelic verbs, could significantly effectively extend pupils' functional linguistic capacity. The sagittal and frontal planes, exploited to represent sequential and durational time, may represent simple and continuous present, past and future simple tenses. Further empirical study of using space-time metaphors may provide theoretical insights regarding pupils' recall of spoken sounds; the semantic impact of their use; pupils' distinction of atelic from telic verbs represented on sagittal and frontal planes.

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