

# Why Plato needs psychology. Proposal for a theoretical framework underpinning research on the cognitive transfer effects of studying classical languages

Alexandra Vereeck<sup>1</sup>, Mark Janse<sup>1</sup>, Katja De Herdt<sup>2</sup>, Arnaud Szmalec<sup>3,4,5</sup>, Cathy Hauspie<sup>3</sup> and Wouter Duyck<sup>3,6</sup>  
<sup>1</sup>Linguistics, Ghent University, Ghent, Belgium  
<sup>2</sup>Literature, Ghent University, Ghent, Belgium  
<sup>3</sup>Department of Experimental Psychology, Ghent University, Ghent, Belgium  
<sup>4</sup>Psychological Research Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium  
<sup>5</sup>Institute of Neuroscience, Université catholique de Louvain, Louvain-la-Neuve, Belgium  
<sup>6</sup>Interdepartmental Research Group Vocational and Personnel Psychology, Ghent University, Ghent, Belgium

**Abstract:** Psychology is one of the seven hub sciences, which involves great responsibility for psychologists but also great opportunities for both psychologists and other scholars; that was the theme of the 17<sup>th</sup> European Congress of Psychology organized by the Slovenian Psychologists' Association. This article contains a detailed example of how psychology functions as a hub science today. The research topic finds its origin in the seemingly unrelated discipline of classics. Latin and Ancient Greek have been taught in Europe for centuries, and even today there are many pupils in secondary education who study them. This custom does not go uncriticized, as the classical languages are often perceived as irrelevant in the modern world. Classicists have therefore been forced, and continue to be forced, to defend the very existence of their discipline. One of the arguments they have adduced, is that the study of classical languages has a beneficial impact on pupils' linguistic and general cognitive abilities. This claim is closely related to the general issue of transfer of learning which has long preoccupied philosophers and psychologists. The only way to verify such a claim, is to resort to a psychological approach. This article presents the first fully elaborated theoretical framework for the cognitive impact of classical language education, which paves the way for sound and rigorous research on this topic. The framework starts from cognitive transfer as a central construct and goes on to combine insights from various psychological and non-psychological literatures. As such, a fruitful interaction comes about: Not only does psychology contribute to classical language impact research, the latter will also enrich cognitive psychology and psycholinguistics by broaching new terrain.

**Keywords:** hub science, cognitive transfer, transfer of learning, classical language education

## Zakaj Platon potrebuje psihologijo? Predlog teoretičnega okvirja za raziskave o kognitivnem transferju učinkov študija klasičnih jezikov

Alexandra Vereeck<sup>1</sup>, Mark Janse<sup>1</sup>, Katja De Herdt<sup>2</sup>, Arnaud Szmalec<sup>3</sup>, Cathy Hauspie<sup>3</sup> and Wouter Duyck<sup>3</sup>  
<sup>1</sup>Lingvistika, Univerza v Ghentu, Ghent, Belgija  
<sup>2</sup>Literatura, Univerza v Ghentu, Ghent, Belgija  
<sup>3</sup>Oddelek za eksperimentalno psihologijo, Univerza v Ghentu, Ghent, Belgija  
<sup>4</sup>Inštitut za psihološke raziskave, Katoliška univerza v Louvainu, Louvain-la-Neuve, Belgija  
<sup>5</sup>Inštitut za nevroznanost, Katoliška univerza v Louvainu, Louvain-la-Neuve, Belgija  
<sup>6</sup>Medoddelčna raziskovalna skupina za psihologijo dela in kadrovske psihologije, Univerza v Ghentu, Ghent, Belgija

**Povzetek:** Psihologija je ena od sedmih vozliščnih znanosti, kar po eni strani psihologom nalaga veliko odgovornost, po drugi pa tako za psihologe kot druge znanstvenike prinaša mnogo priložnosti. Navedeno je bila tudi tema 17. Evropskega kongresa psihologije, ki ga je organiziralo Društvo psihologov Slovenije. V članku je podrobno predstavljen primer delovanja psihologije kot vozliščne znanosti. Raziskava svojo vsebino črpa iz na videz nepovezanega področja klasične filologije. Poučevanje latinščine in stare grščine ima v Evropi večstoletno tradicijo, še danes pa se teh jezikov učijo številni dijaki. Hkrati pa je tradicija učenja klasičnih jezikov tudi predmet očitkov, saj so ti v sodobni družbi pogosto zaznani kot nepomembni. Klasični filologi so zato prisiljeni, da branijo sam obstoj svoje stroke. Eden od njihovih argumentov je ta, da ima študij klasičnih jezikov pozitiven učinek na jezikovne in splošne spoznavne zmožnosti dijakov. Ta predpostavka je tesno povezana s splošnim vprašanjem transferja pri učenju, ki že dolgo zaposluje filozofe in psihologe. Edini način, da to tezo podpremo, je da se zatečemo k psihološki metodi. Članek predstavlja prvi celostno elaboriran teoretični okvir za opisovanje kognitivnega učinka učenja klasičnih jezikov in utira pot za metodološko ustrezno in rigorozno

\*Naslov/Address: Alexandra Vereeck, Linguistics, Ghent University, Rozier 44, 9000 Ghent, Belgium, e-mail: alexandra.vereeck@ugent.be

Članek je licenciran pod pogoji Creative Commons Attribution 4.0 International licence (CC-BY licenca).  
The article is licensed under a Creative Commons Attribution 4.0 International License (CC-BY license).

raziskovanje na tem področju. Teoretični okvir izhaja iz kognitivnega transferja kot osrednjega konstrukta in ga združuje z vpogledi iz psihološke in druge literature. Tako se vzpostavi plodna interakcija: ne samo, da psihologija prispeva k pomembnosti raziskovanja klasičnih jezikov, ampak s poseganjem na nova področja znanja oplaja tudi kognitivno psihologijo in psiholingvistiko.

**Ključne besede:** vozliščna znanost, kognitivni transfer, transfer učenja, poučevanje klasičnih jezikov

During the bustling and buzzing 17<sup>th</sup> edition of the European Congress of Psychology in Ljubljana, the first author had the pleasure of presenting a poster entitled “A debate in need of data. Report of an empirical study on the cognitive transfer effects of studying classical languages” (Vereeck et al., 2022). With this article we would like to expand on one aspect of that presentation. In particular, we want to give a more complete and detailed account of the underlying theoretical framework, because we believe it nicely exemplifies how psychology functions as a hub science today. The central construct stemming from cognitive psychology, this theoretical framework combines insights from various psychological and non-psychological literatures in order to shed light on a problem originating in an entirely different discipline, namely classics.

First, we shall briefly reiterate the research topic: the cognitive impact of classical language education. In Europe, the instruction of Latin and Ancient Greek has a longstanding tradition and is still an important part of most educational systems. Nevertheless, across decades and countries, the value of studying these ancient languages has been the subject of fierce public debate. In reaction to criticisms about their perceived futility and irrelevance in today’s world, classicists and other proponents have suggested that the study of classical languages transfers to other cognitive domains, resulting in improved native as well as foreign language abilities, analytical reasoning skills, and so on. To this day, however, the alleged transfer benefit amounts to little more than an apologetic topos, not (yet) proven by scientific evidence.

As may already be inferred from the title and the description of the research topic, the central construct here is cognitive transfer. Although there has been some research into the linguistic and other benefits of studying classical languages (Bracke & Bradshaw, 2020; Vereeck et al., 2023) and these have even been connected with cognitive transfer before (e.g., De Bruyckere et al., 2020), this article will present what is to our knowledge the first proposal of a fully elaborated theoretical framework for the issue at hand. Given the age-long history of the debate on classical language education (Vereeck, in-press), such a theoretical framework is definitely a desideratum, as it is a necessary condition for sound and rigorous research.

## A definition of cognitive transfer

Let us begin by defining the central construct. Cognitive transfer is the mechanism where learning one task, say Latin grammar, has a favorable impact on performance on another task, say native language ability. These tasks are respectively called the training task and the transfer task. There are two types of cognitive transfer. On the one hand, transfer is said to be “near” if the tasks are similar, that is if they fall within the same cognitive modality – for example linguistic competence. On the other hand, transfer is said to be “far”

if the tasks are dissimilar, that is if they fall within different cognitive modalities. In many studies on cognitive transfer one will find a definition along these lines (e.g., Harrison et al., 2013), whereby similarity is conventionally interpreted as the extent to which the task domains share common features.

There is more to cognitive transfer than is captured by this intuitive definition, however, which is why Barnett and Ceci (2002) have devised a transfer taxonomy. In their taxonomy the multifaceted conditions of transfer are broken down into two global factors, the content and the context. Both of these global factors are broken down further into several independent dimensions. The content factor is subdivided into the specificity of the learned skill, the memory demands, and the nature of the performance change. To paraphrase, a skill that is learned during the training task, specific or generic, is remembered and activated during the transfer task, be it prompted or unprompted, and thus affects the speed, accuracy, or approach of performance on the transfer task. The context factor is subdivided into the knowledge domain, the physical context, the temporal context, the functional context (e.g., academic or informal), the social context (e.g., individual or in group), and the modality (e.g., written or oral). Importantly, the training and the transfer task can be less or more similar along each of the six dimensions of the context factor. Instead of just two different types of cognitive transfer, near and far, theoretically there are now sixty-four (2<sup>6</sup>).

But it does not end there. It is not enough to take into account the transfer conditions in all its facets; transfer effects ought to be studied in relation to the participants’ characteristics as well. As adequately discussed by von Bastian and Oberauer (2014) in their review of working memory training, research indicates that cognitive performance is affected by an array of individual characteristics. These include age, initial cognitive ability, genetic predispositions, motivation, and personality traits such as neuroticism and conscientiousness. Additionally, people’s beliefs about or awareness of the different conditions in a research design can also influence their performance (Green et al., 2019). In an attempt to give due attention to inter-individual differences and participant expectations, whilst matching the terminology of the transfer taxonomy, in what follows this third factor will be termed the individual factor.

## A concise history of cognitive transfer research

Transfer of learning has fascinated people as long as learning itself. In Classical Greece, Plato, inspired by Pythagoras, already voiced the idea that musical instruction ought to be the basis of all education, for mastering musical harmony would lead to a more harmonious character. He also recommended thorough mathematical instruction: A mind well versed in mathematical problems can solve any problem at all, he believed (Stellwag, 1949). From the Renaissance

onwards, this special educational position was bestowed upon the study of classics. Historically, there is therefore a strong link between the concept of cognitive transfer and classical language education.

It was not until the Enlightenment that the idea really gained ground that mental capacities could be trained in the same way as muscles, by applying them to subject matter with a formative value. In Locke's and Kant's writings, for example, we clearly find this theory of mental discipline (Stellwag, 1949). While the term "mental discipline" may be old-fashioned and outdated, it essentially describes nothing else than transfer of learning. In the nineteenth century, a lively scholarly debate developed itself about the possibility of a formal training which would have broad transfer effects (Castiello, 1934).

When psychology tore itself loose from philosophy and adopted the scientific method, cognitive transfer could no longer be dogmatically accepted or rejected, but its existence had to be empirically verified. Charles Spearman (1927, p. 163) even referred to it as "the most vital of all educational problems". His theory of intelligence is reconcilable with the possibility of transfer. According to Spearman (1904), general intelligence underlies all branches of intellectual activity, so provided it can be trained, transfer to a great many specific activities is conceivable. His contemporary Edward Thorndike was of a different opinion. After running several experiments (notably Thorndike & Woodworth, 1901a, 1901b, 1901c) in which participants fulfilled tasks under slightly different training and transfer conditions, he formulated the theory of identical elements (Thorndike, 1914), which is still invoked today (e.g., De Bruyckere et al., 2020). This theory states that transfer is directly proportional to the number of elements in common between two tasks, which strictly interpreted equals a negation of the existence of proper cognitive transfer.

Many other psychologists also took an interest in this vital educational problem, so that by the time the nineteen-thirties came round, over a hundred transfer experiments were known (Castiello, 1934). Methods gradually improved, yet results and conclusions greatly differed. Thus the field of cognitive transfer research grew into one of extreme positions and little consensus. For all the progress we have made in our understanding of human cognition, even today the likelihood of transfer is still a matter of scholarly debate. It ranges from hopeful optimism (e.g., Barnett & Ceci, 2002; Green et al., 2019; Jaeggi et al., 2014) to uncompromising skepticism (e.g., Gobet & Sala, 2022; Harrison et al., 2013; Shipstead et al., 2010). A prominent subset of modern cognitive transfer research has come to focus on working memory in particular (von Bastian & Oberauer, 2014).

In short, cognitive transfer is a hot topic in psychology, past and present. A few years ago, Sala, Gobet and colleagues (2019) performed a second-order meta-analysis of recent research on cognitive training programs. They found unequivocal evidence for the occurrence of near transfer from working memory training to memory tasks, especially in normally developing children. The existence of far transfer could not be confirmed, partly due to methodological problems in far transfer studies like placebo effects, publication bias and lack of statistical power. The explanation Gobet and Sala (2022) proposed for the pattern of results across studies, is that the between-study variance mainly springs from sampling error

and that the true effect size of far transfer, when corrected for placebo effects and publication bias, is actually zero.

According to an article composed by forty-eight leading scientists in the field, however, "the absence of clear methodological standards has made it difficult-to-impossible to easily and directly compare results across studies (either via side-by-side contrasts or in broader meta-analyses)" (Green et al., 2019, p. 3). They also argued that each type of behavioral intervention for cognitive enhancement is too different to study them all together under one overarching category. Indeed, lumping large amounts of research together, which is of course the very point of a meta-analysis, contradicts the philosophy of Barnett and Ceci (2002) and is bound to lead to negative conclusions, as far as cognitive transfer is concerned. As highlighted by the transfer taxonomy, there are always several dimensions to be taken into account: Transfer might occur in some configurations of these dimensions and not in others. Therefore, a lack of significant and replicable far transfer effects in a certain type of situation does not mean that the possibility of far transfer is to be dismissed altogether.

## Applying the cognitive transfer construct to classical language education

Is the study of classical languages useful, in the (narrow) sense that pupils become better readers, writers and thinkers than they otherwise would have been? This question can readily be rephrased as a cognitive transfer issue. The training task consists of classical language education, as offered by the local educational system. The transfer task can be anything which is mentioned as a likely benefit of classical language education. Language-related effects may be considered near transfer, whereas effects on general cognitive abilities and not language-related achievement may be considered far transfer. As simple and obvious as the preceding perhaps sounds, the impact of classical language education has yet to be truly viewed from this perspective and its potential cognitive transfer effects have yet to be verified.

### The training task

Now, let us try to grasp the training task in more detail. To this end, it is necessary to introduce another core construct, being language complexity. Linguists use this term in multiple ways<sup>1</sup>. The relevant approach here is the psycholinguistic

<sup>1</sup> The literature reveals at least four approaches to defining complexity (Housen, 2020; Housen & Simoens, 2016). Some define it in terms of developmental timing (1), a central concept in the Processability Theory on second language acquisition (see for example Pienemann & Lenzing, 2015). According to this theory, a linguistic feature is more complex than another feature if it takes more time to emerge or to be fully mastered. The pedagogic approach (2) focuses on the complexity of descriptions and explanations provided to learners to help them acquire or use a second language feature: their elaborateness, the amount of meta-language, the degree of conceptual clarity or abstractness of the terminology, etc. These two approaches have no bearing on the current theoretical framework. Then there is the linguistic approach (3), which can in itself be seen as one aspect of the psycholinguistic approach (4).

one (Housen, 2020): Complexity then refers to the cognitive effort and resources deployed to process language features in second language learning and use. The complexity a learner experiences emanates from the language features themselves, from a multitude of learner characteristics, among which age, motivation and the distance between the first and the second language, and from the learning context, where second language acquisition theory makes a distinction between explicit and implicit settings.

The inconstant sum of feature-related, learner-related and context-related complexity is sometimes called relative complexity, as opposed to absolute or structural complexity, which is an unchanging property of individual language features. Linguistically speaking (Housen, 2020), phonological, lexical, and grammatical features are complex or not, depending on the internal structuring of linguistic units and their interconnections with other linguistic units. Structural complexity can be of a purely formal nature or rather of a functional nature, the latter being determined by how many functions a linguistic unit has and how transparent the form-function mappings are.

For decades, it was common knowledge in the field of linguistics that the overall absolute complexity of every language was the same, an axiom known as the principle of invariance of language complexity, the ALEC-statement (an acronym for “all languages are equally complex”), or the equi-complexity dogma (Becerra-Bonache & Jiménez-López, 2015; Sampson, 2009). This axiom has been refuted and is no longer universally accepted by present-day linguists (e.g., Joseph & Newmeyer, 2012; Gil et al., 2009). Researchers have in fact detected differences in total complexity between languages (e.g., Dahl, 2009; McWhorter, 2001). The assumption behind complexity invariance, namely that complexity or a lack thereof in one linguistic area is compensated for in another, does not hold up either. Morphological and syntactical complexity do not by default balance each other out, but tend to go hand in hand, especially when a language has case marking: As Dahl (2009) remarks, morphological distinctions between cases are only viable if there are syntactic rules fixing their distribution.

So, where do the classical languages stand in all this? In brief, Latin and Ancient Greek are without a doubt pretty complex. The number one characteristic causing complexity is their extensive inflectional morphology – those familiar with either language need but think of the many noun and verb classes. By means of argumentation, the interested reader will find more information as well as other characteristics in Table 1. The overall complexity of Ancient Greek has actually been shown to be very significantly higher than that of modern Indo-European languages (Bentz et al., 2022, p. 13). The features that make the classical languages complex in the absolute sense simultaneously make them complex in the relative sense for learners, compared with Western first languages and with modern second languages commonly studied in Western secondary school systems.

Still to be discussed is the learning context. Besides their linguistic make-up, the way classical languages are taught sets them apart from their modern counterparts<sup>2</sup>. Pertinently, the main objective of Latin and Greek classes is not being able

to communicate in everyday situations, but being able to read and analyze sophisticated literary texts. The combination of high structural complexity and the singular goal of building a reading knowledge explains why – unlike in modern foreign language classes – the predominant teaching paradigm<sup>3</sup> is explicit instruction aimed at a passive knowledge of vocabulary and grammar.

In this particular learning context, pupils probably draw more heavily upon declarative rather than procedural memory. Thanks to neurocognitive research on second language acquisition (overview by Ullman, 2015), it is known that whereas implicit learning opportunities such as language immersion lead to more language learning in procedural memory, explicit classroom instruction encourages language learning in declarative memory. Classical language education as customarily practiced represents the explicit classroom setting *par excellence*: Pupils are confronted with no natural oral language use whatsoever, and are trained exclusively in the skill of reading. The exposure to classical texts, however, is too limited to allow for solid proceduralization of linguistic knowledge or reading ability. Low second language exposure has indeed been found to correlate with learning in declarative memory as well (Ullman, 2015).

When studying classical languages, a lot of time and effort is directed towards the language system: rote learning of large amounts of vocabulary, memorizing many declensions and conjugations including exceptions, and getting a grip of countless grammatical rules and irregularities. Declarative memory is crucial for absorbing idiosyncratic information such as vocabulary or irregular morphological forms. In addition, and in competition with procedural memory, declarative memory is also available for learning grammatical rules and rule-governed forms. Coincidentally, for this it is chiefly used in the event of explicit classroom instruction or low exposure (Ullman, 2013; Ullman, 2015).

To summarize the training task, classical language education teaches pupils structurally complex languages

<sup>2</sup> In the controversy around the usefulness of classical language education, a recurring suggestion is whether youngsters would not be better off studying languages like Russian, Arab or Chinese instead. These languages can also be regarded as complex, both absolutely and relatively, so that instruction therein could hypothetically have comparable cognitive effects. Of all three the most eligible candidate for near transfer would probably be Russian, which as a Slavonic Indo-European language is still sufficiently similar to promote direct insight in Germanic and Romance languages and thus produce transfer effects to pupils' native language ability. In practice, however, these modern languages would never be taught in the same way as the classical languages; the focus would rightly lie on communication. With Latin and Ancient Greek it is a different story. Through the lens of the cognitive transfer framework, they are therefore not interchangeable. Furthermore, there are obvious cultural-historical arguments that can be adduced.

<sup>3</sup> Some teachers diverge from this paradigm and try to model classical language learning as much as possible after natural language acquisition. Although the so-called communicative method (Lloyd & Hunt, 2021) has gained popularity in recent years, in the whole of Europe it is quantitatively of minor significance.

(feature-related) with a certain distance to their mother tongue (learner-related) by means of a teaching method that appeals to acquisition in declarative memory (context-related). Unlike procedural knowledge, which is hyper-specialized, declarative knowledge is flexible, broadly available,

consciously accessible, and utilizable in circumstances that only indirectly resemble the original conditions of learning (Squire & Wixted, 2011). Hence, declarative acquisition of a complex language system constitutes a learning task that is not unlikely to result in cognitive transfer; of course, at

**Table 1**  
*Structural Complexity of the Classical Languages*

---

**Functional structural complexity**

- multiple form-function mappings  
For example, inflectional morphology, where a single ending conveys multiple grammatical categories like case, gender and number at once. These fusional endings are more complex than features with a one-to-one mapping.
- opacity of a form-function mapping  
For example, the variable functions of cases. The accusative for instance is ambiguous in that it can indicate both an object or an adverbial.
- communicative redundancy  
For example, the Greek augment in particular and tense marking in general. Tense marking is redundant when other cues to the time frame are present.
- optionality of a feature  
For example, null subjects. Subject expression is optional in Latin and Greek.

**Formal structural complexity**

a) Morphological complexity

- declensional and conjugational allomorphy (i.e. the encoding of distinctions between noun and verb classes)  
For example, the numerous declension and conjugation types. Encoded allomorphy is a complexifying by-product of inflectional morphology.
- arbitrary allomorphy  
For example, variation in the way the principal parts of the verb are formed. To illustrate, the Latin verb *moneo* has perfect *monui*, whereas *maneo* has *mansi*. Arbitrary allomorphy adds another layer of complexity within the noun and verb classes.
- additional morphophonemics  
For example, positional variants of stems. To illustrate, the Latin word for “name” is *nomen* in the nominative, but uses the stem *nomin-* in other cases. Such morphophonological processes are likely to develop in inflecting languages, which creates an extra component of grammar to be learned.
- marking of agreement  
For example, agreement of case, gender, number, and so on. Agreement can get particularly complex with embedded relative clauses or with noun phrase hyperbata, since a hyperbatic placement increases the number of intercurrent constituents between a linguistic unit and its nearest head or dependent, in itself a hallmark of complexity. Generally, agreement-marking inflection renders a grammar inherently more complex.
- number of constituent components of a feature  
For example, compound or circumscribed forms like *amatus sum*, *pugnaturus est*, *λελυκώς ὃ* (*lelukōs ὃ*) et cetera. They require multiple components for one paradigm slot, which is more complex than a single component.

b) Syntactic complexity

- asymmetries between matrix and subordinate clauses  
For example, the usage of mood and tense, notably the relative usage in Latin and the aspect in Greek. These characteristics augment the syntactic complexity by increasing the number of rules to process.

c) Semantic complexity

- fine subdivisions requiring overt specification  
For example, the obligatory expression of modality by verbal mood and tense. Overt and grammaticalized expression of such fine-grained semantic distinctions makes the grammar more complex.
- semantically opaque or arbitrary case government  
For example, verbs governing different cases for their first object. Several possibilities mean more processing and thus more complexity.

---

*Note.* The categories are adapted from Housen, 2020; Housen & Simoens 2016; and McWhorter, 2001. The examples are our own.

present, this is but a hypothesis regarding the underlying learning mechanisms<sup>4</sup>. The first point on the research agenda is to empirically establish whether any transfer effects of classical language learning do in fact occur.

### The content factor

Following the transfer taxonomy (Barnett & Ceci, 2002), it must be specified what is transferred – also known as the content factor – and when and where it is transferred from and to – also known as the context factor. To recapitulate, the content factor encompasses the specificity of the skill learned during the training task, the memory demands of the transfer task, and the nature of the change in performance on the transfer task. The application of these last two dimensions is straightforward. Under the hypothesis that studying classical languages produces cognitive transfer effects, we expect that after having studied classical languages pupils will perform better, that is more accurate, on a set measurement (see paragraph on the context factor), without being at all prompted that the skills learned in Latin or Greek class could be of any help. Since subjects have to select and execute a task approach by themselves, the memory demands are recall, recognition and execution. The assessed performance change is accuracy, rather than speed or something else.

As for the skills learned by engaging in the study of classical languages, they can be formulated at different levels of specificity. An example of a language-specific transferrable skill is deconstructing complex words and sentences to discover their meaning, which could come in handy while performing modern language tasks. The language-specific skills can also be reformulated and used at a more generic level: Examples are pattern recognition, learned for instance by looking for regularities in inflection, and analytical reasoning, learned for instance by parsing long sentences, which could be used while performing a wide range of problem-solving tasks. In case of a broadly defined training task like classical language education, the activated skill and its specificity will vary according to the transfer task.

### The context factor

The dimensions of the context factor can be filled in as follows, starting with the knowledge domain. With regard to the training task, the knowledge domain is classics, in particular the Latin and/or Ancient Greek language. With regard to the transfer task, knowledge domains that have aroused interest as possible areas of transfer are: native language ability, modern foreign language ability, general

cognitive ability, and school achievement. The modality is, primarily, written. The physical, temporal, functional, and social contexts are undetermined, in that they depend on the research study. In previous research (see Bracke & Bradshaw, 2020; Vereeck et al., 2023), the tasks mostly take place in the pupils' school environment during school hours. If the transfer task consists for instance of a standardized language test administered by a researcher or educator, it resembles regular school tests in its academic function and individual execution, the only difference being that the stakes are lower if the pupils' performance on this test does not count towards their grades.

Barnett and Ceci (2002) pointed out that the training and the transfer task can be near to each other or far apart along each of the dimensions of the context factor. When it comes to measuring the cognitive impact of classical language education, the largest differences exist on the knowledge domain dimension. Therefore, it makes sense to operationalize near and far transfer in relation hereto. Potential linguistic benefits of the study of classical languages – or in other words, crosslinguistic transfer to native language ability, modern foreign language ability, or achievement in language courses – should be labeled near transfer. Potential general cognitive benefits – or in other words, transfer to general cognitive ability or achievement in other courses like mathematics and sciences – should be labeled far transfer.

### The individual factor

Ultimately, cognitive transfer is a matter of human behavior, hence the importance of the individual factor. For classical language pupils no less than for other research participants, characteristics that may have a confounding influence on the cognitive transfer process must be taken into account. Besides age, gender, socio-economic status, motivation, and personality, a key variable to consider is initial cognitive ability. Transfer can only be meaningfully evaluated if any additional effect from the training task can be isolated and distinguished from the effect of initial cognitive ability. Study options are not assigned randomly, so they are usually correlated with demographic and other individual-difference variables (Green et al., 2019). In other terms, there is a high risk of selection bias. Study options are also liable to prejudices and stereotypes, above all Latin and Greek, which is why measures are needed to minimize any Pygmalion effects and stereotype threat effects.

## Supporting and related literatures

So far we have reframed one of the pivotal moot points in the classical language debate as a psychological issue of cognitive transfer. Given that the sheer existence of cognitive transfer is not a foregone conclusion, except perhaps for very near transfer as a result of working memory training, the theoretical framework is not quite complete yet. What basis is there to expect transfer effects of classical language learning? As laid out in this section, there is a number of research findings from diverse scientific fields on the basis of which such transfer effects seem, at the very least, plausible.

<sup>4</sup> Some preliminary confirmation for this hypothesis can for example be seen in educational research on generic skills like critical thinking, which has shown that transfer of critical thinking skills is only achieved if they are taught explicitly within a meaningful domain-specific context (e.g., Tiruneh et al., 2018). The fact that teaching method is decisive for learning outcomes *tout court* is well-documented in both cognitive transfer research (e.g., Karbach & Kray, 2009) and second language acquisition research (e.g., Bagheri et al., 2019).

## Near transfer / Linguistic benefits

The linguistic benefits have been extensively studied in the United States in the course of the twentieth century. Without going into more detail here, this research is outdated and has many methodological shortcomings and generalizability problems (Bracke & Bradshaw, 2020; Vereeck et al., 2023). It is a substantial body of research nonetheless, which may be taken as suggestive evidence. Numerous American studies found a positive effect of Latin instruction on English word knowledge (see for example Masciantonio, 1977), with both Latin-derived words and words of Anglo-Saxon or other origin (e.g., Gilliland, 1922). English reading ability was found to be positively impacted by Latin instruction as well: One report on a second language program even noted more progress and higher absolute levels after one year of Latin than after four years of French or Spanish (Mavrogenes, 1977, p. 270). The improvement in reading ability might in part be a consequence of the improvement in word knowledge, for it is a well-known fact in the fields of first language acquisition (e.g., Hacquebord, 2006) as well as second language acquisition (e.g., Hu & Nation, 2000) that vocabulary size and text comprehension are closely connected.

Furthermore, the possibility of near transfer from the classical languages to the native language is supported by second language acquisition research on bidirectional crosslinguistic transfer. While since its early days the field of second language acquisition has traditionally focused on unidirectional transfer from the first language to the second, in later decades attention increased for the influence of second language learning on first language proficiency. In her acclaimed multicompetence framework, Cook (1991) urged that people who know more than one language have a compound state of mind, distinct from the sum of two or more monolingual states.

Later, models of multilingualism have been proposed inspired by Complexity Theory (Larsen-Freeman, 2015, 2020), a modern transdisciplinary theory concerned with complex systems that is well-applicable to language and language acquisition. Their fundamental principle is that, just as so much in this world, language and language acquisition need to be seen as complex and dynamic, rather than static and stable. Being preoccupied with change and adaptation, Complexity Theory “inspires the thinking that a multilingual system expands the language resources from which a multilingual may draw, the use of one language affects the use of another, and thus the influence between languages is bidirectional” (Larsen-Freeman, 2015, p. 230).

Research on bidirectional crosslinguistic transfer endorses the idea that second language learning is a dynamic action with potential consequences for first language proficiency. In bilingual adults, transfer has been observed across all areas of their native language independently of context factors, which points towards a formal restructuring of linguistic competence (Pavlenko & Jarvis, 2002). Studies with small children show that learning a second language with a transparent correspondence between oral sounds and written letters, such as Italian, aids the development of native literacy in a language where this correspondence is less transparent,

such as English. Murphy et al. (2015, p. 1151) draw the conclusion that second language learning “can also be viewed as language awareness training: an appreciation for, and understanding of language as a system of sounds, words, and structure that can be manipulated in different ways”.

When reviewing the above results of second language acquisition research, we must keep in mind the differences and similarities with classical language learning. The main differences are that Latin and Ancient Greek are not used for oral or written production in secondary education<sup>5</sup>, and that pupils’ active knowledge is minimal. A similarity is that these languages do also have a high correspondence between oral sounds and written letters. Moreover, classical language education in particular qualifies as language awareness training: Its transfer value may very well lie in general language principles and the approach of language as a system. At any rate, it has been known for some time now that second language instruction is beneficial for first language performance (as already noted by Ganschow & Sparks, 1995).

## Far transfer / General cognitive benefits

Prior research on the general cognitive benefits of studying classical languages is virtually limited to one experiment, also conducted in the United States some decades ago. In this experiment, Latin pupils made considerably more progress in not only English but in mathematics as well, compared to pupils with similar socio-economic and academic profiles who did not take Latin (Masciantonio, 1977, pp. 377–378; Mavrogenes, 1977, p. 270). Within the classic lab-based research on cognitive transfer, far transfer does not have a great track record and, as noted above, is still surrounded by scepticism. Even so, the suggestion that the study of classical languages could elevate general cognitive ability is supported by two other research lines. The broad notion that cognitive ability is susceptible to environmental factors is corroborated by psychological research on intelligence, and the more specific notion that second language learning boosts intelligence is corroborated by psycholinguistic research on the cognitive effects of multilingualism and second language acquisition, above all the bilingual advantage.

Research on the malleability of intelligence has amassed a large amount of evidence that intelligence, as gauged by an IQ score, can and does change considerably depending on environmental factors like the opportunity to acquire or practice certain mental capabilities. This evidence comes from various sources: adoption studies, intervention studies, studies on schooling effects, studies on nutritional effects, studies on generational changes, and so on (Sauce & Matzel, 2018). A person’s IQ scores may be relatively stable from one year to the next, but that does not mean intelligence is an entirely inherent and unalterable quality. In a meta-analysis of the effect of education on intelligence, Ritchie and Tucker-Drob (2018) discovered that IQ consistently increases with approximately one to five points per additional year of schooling. From there it is not a far stretch to hypothesize that

<sup>5</sup> That is, not taking into account the communicative method already mentioned in the third footnote.

particular types of education could have a more pronounced effect on cognitive ability than other types.

The bilingual advantage in cognitive functioning has been a avidly studied topic in psycholinguistics since in the sixties<sup>6</sup> research demonstrated that bilingualism was not detrimental to the mind, as contemporary consensus had it, but rather an advantage in intellectual reasoning (Peal & Lambert, 1962). Modern research has frequently associated bilingualism with improved working memory and especially improved executive control (e.g., Bialystok et al., 2005; Bialystok & Barac, 2012; Carlson & Meltzoff, 2008). It must be said that, like with cognitive transfer, not all research supports the existence of a bilingual advantage in executive functioning (e.g., Dick et al., 2019; Paap, 2023). The first longitudinal study assessing the cognitive effect of becoming a bilingual within participants was conducted by Woumans et al. (2016). Using a matched comparison group design, they noted significant gains in non-verbal intelligence scores for the bilingual group, thus making a solid case for far transfer as a result of second language learning.

### Related topics

Besides classical language instruction, there are other kinds of instruction commonly thought to have a beneficial impact that stretches beyond the training domain, in particular instruction in music, chess, and programming. Despite the resemblance, only the latter three seem to occupy an established place within the psychological cognitive transfer literature, whereas the classical languages do not. On a side note, Green et al. (2019) in fact see a trichotomy in the literature: (1) cognitive training in the strictest sense, (2) related behavioral interventions (among which musical interventions and the like) that are on the radar of cognitive enhancement research, and (3) other relevant contexts that could come up in educational or clinical research.

Music training has been associated with enhanced general cognitive ability, spatial ability, executive control and various language skills, and chess training has been linked to improvement on general-cognitive measures among which fluid intelligence, processing speed and working memory (Hille et al., 2011; Janus et al., 2016; Sala & Gobet, 2017). Just like research on the classical languages, however, research on music and chess has suffered from methodological shortcomings such as the lack of control for selection bias and the absence of active comparison groups, which prevent a definitive conclusion about their true transfer value (Sala & Gobet, 2017). Computer programming, on the other hand, has proven transfer effects to creative thinking, mathematical skills, metacognition, spatial skills and reasoning (Scherer et al., 2019).

### Conclusion

One could say psychology is deemed a hub science because of its high transfer value: The theories, methods, and findings have a profound impact outside of the realm of psychology itself. As this article illustrates, the adoption of a psychological approach can shed new light on scholarly problems originating from different disciplines. Moreover, it can even be the driving force towards resolving them. The old American research on classical language education lacked a theoretical framework. In general, the supposed secondary benefits of studying classical languages have not been approached as fundamentally a phenomenon of human cognition and language learning, and the influence of participant characteristics and expectancy effects has largely been overlooked. The framework presented here defined classical language learning as a specific type of cognitive training, akin to other research topics such as crosslinguistic transfer, the bilingual advantage, and music education. We also discussed the various factors that can affect the possible transfer resulting from this training. These insights ought to be translated into the designs of future empirical research on the topic<sup>7</sup>.

The exploration of new topics can also yield worthwhile expansions of existing psychological literatures. Just like psychology contributes to classical language impact research, the reverse is true too. In their methodological manifesto, Green and his assembly of scientists (2019) remark that the link between lab tests and real-world outcomes is not always clear, and that studies on the effectiveness of real-world behavioral interventions for cognitive enhancement are rare. Since so much of the classic research on cognitive transfer has relied solely on lab-based experiments, field data from an already existing and heavily discussed educational situation will be an invaluable contribution to this branch of research. Furthermore, the focus on classical languages will be an interesting addition to the literature concerning the bilingual advantage, as well to the field of second language acquisition.

### References

- Bagheri, M., Hadian, B., & Vaez-Dalili, M. (2019). Effects of the Vaughan method in comparison with the Audiolingual method and the communicative language teaching on Iranian advanced EFL learners' speaking skill. *International Journal of Instruction*, 12(2), 81–99.
- Barnett, S., & Ceci, S. (2002). When and where do we apply what we learn? A taxonomy for far transfer. *Psychological Bulletin*, 128(4), 612–637.

<sup>6</sup> Long before that, the Russian child psychologist Lev Vygotsky (1896-1934) already proclaimed the beneficent nature of foreign language instruction (Fredericks, 1974). During his life Vygotsky's writings were not influential in the West, but later he became a famous name in the field of educational psychology for, among other things, his theory of the zone of proximal development.

<sup>7</sup> For the first time in the history of the educational debate about the cognitive impact of classical language education, we are applying psychological research paradigms regarding the cognitive effects of multilingualism and second language acquisition to classical language learning in our ongoing research at Ghent University. This research is funded by The Research Foundation – Flanders (FWO), grants 1110621N and G049821N.

- Becerra-Bonache, L., & Jiménez-López, D. (2015). A grammatical inference model for measuring language complexity. In I. Rojas, G. Joya, & A. Catala (Eds.), *Advances in computational intelligence*. 13th International Work-Conference on Artificial Neural Networks, IWANN 2015, Palma de Mallorca, Spain, June 10-12, 2015 (Vol. 1). Springer.
- Bentz, C., Gutierrez-Vasques, X., Sozinova, O., & Samardžić, T. (2022). Complexity trade-offs and equi-complexity in natural languages: A meta-analysis. *Linguistics Vanguard: A Multimodal Journal for the Language Sciences*, 14(9), 9–25.
- Bialystok, E., & Barac, R. (2012). Emerging bilingualism: Dissociating advantages for metalinguistic awareness and executive control. *Cognition*, 122(1), 67–73.
- Bialystok, E., Martin, M., & Viswanathan, M. (2005). Bilingualism across the lifespan: The rise and fall of inhibitory control. *International Journal of Bilingualism*, 9(1), 103–119.
- Bracke, E., & Bradshaw, C. (2020). The impact of learning Latin on school pupils. A review of existing data. *The Language Learning Journal*, 48(2), 226–236.
- Carlson, S., & Meltzoff, A. (2008). Bilingual experience and executive functioning in young children. *Developmental Science*, 11(2), 282–298.
- Castiello, J. (1934). *Geistesformung. Beiträge zur experimentellen erforschung der formalen Bildung* [Formation of the mind. Contributions about the experimental inquiry into formal discipline]. Dümmler.
- Cook, V. (1991). *Second language learning and language learning*. Edward Arnold.
- Dahl, Ö. (2009). Testing the assumption of complexity invariance: the case of Elfdalian and Swedish. In D. Gil, G. Sampson, & P. Trudgill (Eds.), *Language complexity as an evolving variable* (pp. 50–63). Oxford University Press.
- De Bruyckere, P., Kirschner, P., & Hulshof, C. (2020). If you learn A, will you be better able to learn B? Understanding transfer of learning. *American Educator*, 44(1), 30–34.
- Dick, A., Garcia, N., Pruden, S., Thompson, W., Hawes, S., Sutherland, M., Riedel, M., Laird, A., & Gonzalez, R. (2019). No evidence for a bilingual executive function advantage in the ABCD study. *Nature Human Behaviour*, 3(7), 692–701.
- Fredericks, S. (1974). Vygotsky on language skills. *The Classical World*, 67, 283–290.
- Ganschow, L., & Sparks, R. (1995). Effects of direct instruction in Spanish phonology on the native-language skills and foreign-language aptitude of at-risk foreign language learners. *Journal of Learning Disabilities*, 28(2), 107–120.
- Gil, D., Sampson, G., & Trudgill, P. (Eds.). (2009). *Language complexity as an evolving variable. Studies in the evolution of language*. Oxford University Press.
- Gilliland, A. (1922). The effect of the study of Latin on ability to define words. *Journal of Educational Psychology*, 13(8), 501–505.
- Gobet, F., & Sala, G. (2022). Cognitive training: A field in search of a phenomenon. *Perspectives on Psychological Science*, 20(10), 1–17.
- Green, C., Bavelier, D., Kramer, A., Vinogradov, S., Ansorge, U., Ball, K., Bingel, U., Chein, J., Colzato, L., Edwards, J., Facoetti, A., Gazzaley, A., Gathercole, S., Ghisletta, P., Gori, S., Granic, I., Hillman, C., Hommel, B., Jaeggi, S., ... Witt, C. (2019). Improving methodological standards in behavioral interventions for cognitive enhancement. *Journal of Cognitive Enhancement*, 3(1), 2–29.
- Hacquebord, H. (2006). Woordkennis als onderdeel van taaldiagnostisch onderzoek [Word knowledge as part of diagnostic research on language]. *Levende talen*, 7(1), 15–22.
- Harrison, T., Shipstead, Z., Hicks, K., Hambrick, D., Redick, T., & Engle, R. (2013). Working memory training may increase working memory capacity but not fluid intelligence. *Psychological Science*, 24(12), 2409–2419.
- Hille, K., Gust, K., Bitz, U., & Kammer, T. (2011). Associations between music education, intelligence, and spelling ability in elementary school. *Advances in Cognitive Psychology*, 7, 1–6.
- Housen, A. (2020). Difficulty and complexity of language features and second language instruction. In C. Chapelle (Ed.), *The concise encyclopedia of applied linguistics* (pp. 389–395). Wiley Blackwell.
- Housen, A., & Simoens, H. (2016). Introduction: Cognitive perspectives on difficulty and complexity in L2 acquisition. *Studies in Second Language Acquisition*, 38, 163–175.
- Hu, M., & Nation, P. (2000). Unknown vocabulary density and reading comprehension. *Reading in a Foreign Language*, 13(1), 403–430.
- Jaeggi, S., Buschkuhl, M., Shah, P., & Jonides, J. (2014). The role of individual differences in cognitive training and transfer. *Memory & Cognition*, 42(3), 464–480.
- Janus, M., Lee, Y., Moreno, S., & Bialystok, E. (2016). Effects of short-term music and second-language training on executive control. *Journal of Experimental Child Psychology*, 144, 84–97.
- Joseph, J., & Newmeyer, F. (2012). All languages are equally complex. The rise and fall of a consensus. *Historiographia Linguistica*, 39(2–3), 341–368.
- Karbach, J., & Kray, J. (2009). How useful is executive control training? Age differences in near and far transfer of task-switching training. *Developmental Science*, 12(6), 978–990.
- Larsen-Freeman, D. (2015). Complexity theory. In B. VanPatten, & J. Williams (Eds.), *Theories in second language acquisition: An introduction* (pp. 227–244). Routledge.
- Larsen-Freeman, D. (2020). Chaos/complexity theory for second language acquisition/development. In C. Chapelle (Ed.), *The concise encyclopedia of applied linguistics* (pp. 181–188). Wiley Blackwell.
- Lloyd, M., & Hunt, S. (2021). *Communicative approaches for ancient languages*. Bloomsbury Academic.
- Masciantonio, R. (1977). Tangible benefits of the study of Latin: A review of research. *Foreign Language Annals*, 10(4), 375–382.
- Mavrogenes, N. (1977). The effect of elementary latin instruction on language arts performance. *The Elementary School Journal*, 77(4), 268–73.

- McWhorter, J. (2001). The world's simplest grammars are creole grammars. *Linguistic Typology*, 5(2–3), 125–166.
- Murphy, V., Macaro, E., Alba, S., & Cipolla, C. (2015). The influence of learning a second language in primary school on developing first language literacy skills. *Applied Psycholinguistics*, 36(5), 1133–1153.
- Paap, K. (2023). *The bilingual advantage in executive functioning hypothesis: How the debate provides insight into psychology's replication crisis*. Routledge.
- Pavlenko, A., & Jarvis, S. (2002). Bidirectional transfer. *Applied Linguistics*, 23(2), 190–214.
- Peal, E., & Lambert, W. (1962). The relation of bilingualism to intelligence. *Psychological Monographs: General and Applied*, 76, 1–23.
- Pienemann, M., & Lenzing, A. (2015). Processability theory. In B. VanPatten, & J. Williams (Eds.), *Theories in second language acquisition: An introduction* (pp. 159–179). Routledge.
- Ritchie, S., & Tucker-Drob, E. (2018). How much does education improve intelligence? A meta-analysis. *Psychological Science*, 29(8), 1358–1369.
- Sala, G., Aksayli, N., Tatlidil, S., Tatsumi, T., Gondo, Y., & Gobet, F. (2019). Near and far transfer in cognitive training: A second-order meta-analysis. *Collabra: Psychology*, 5(1), Article 18.
- Sala, G., & Gobet, F. (2017). Does far transfer exist? Negative evidence from chess, music, and working memory training. *Current Directions in Psychological Science*, 26(5), 515–520.
- Sampson, G. (2009). A linguistic axiom challenged. In D. Gil, G. Sampson, & P. Trudgill (Eds.), *Language complexity as an evolving variable* (pp. 1–18). Oxford University Press.
- Sauce, B., & Matzel, L. (2018). The paradox of intelligence: Heritability and malleability coexist in hidden gene-environment interplay. *Psychological Bulletin*, 144(1), 26–47.
- Scherer, R., Siddiq, F., & Sánchez Viveros, B. (2019). The cognitive benefits of learning computer programming: A meta-analysis of transfer effects. *Journal of Educational Psychology*, 111(5), 764–792.
- Shipstead, Z., Redick, T., & Engle, R. (2010). Does working memory training generalize? *Psychologica Belgica*, 50(3–4), 245–276.
- Spearman, C. (1904). 'General intelligence', objectively determined and measured. *The American Journal of Psychology*, 15(2), 201–292.
- Spearman, C. (1927). *The abilities of man: Their nature and measurement*. The Macmillan Company.
- Squire, L., & Wixted, J. (2011). The cognitive neuroscience of human memory since H.M. *Annual Review of Neuroscience*, 34, 259–288.
- Stellweg, H. (1949). *De waarde der klassieke vorming. Een cultuur-historische, paedagogisch-psychologische en didactische inleiding* [The value of classical education. A cultural-historical, pedagogical-psychological and didactical introduction]. Wolters.
- Thorndike, E. (1914). *The psychology of learning*. Teachers College.
- Thorndike, E., & Woodworth, R. (1901a). The influence of improvement in one mental function upon the efficiency of other functions. (I). *Psychological Review*, 8(3), 247–261.
- Thorndike, E., & Woodworth, R. (1901b). The influence of improvement in one mental function upon the efficiency of other functions. II. The estimation of magnitudes. *Psychological Review*, 8(4), 384–395.
- Thorndike, E., & Woodworth, R. (1901c). The influence of improvement in one mental function upon the efficiency of other functions: III. Functions involving attention, observation and discrimination. *Psychological Review*, 8(6), 553–564.
- Tiruneh, D., Gu, X., De Cock, M., & Elen, J. (2018). Systematic design of domain-specific instruction on near and far transfer of critical thinking skills. *International Journal of Educational Research*, 87, 1–11.
- Ullman, M. (2013). Declarative/procedural model of language. In H. Pashler (Ed.), *Encyclopedia of the mind* (Vol. 1, pp. 224–226). Sage Publications.
- Ullman, M. (2015). The declarative/procedural model. A neurobiologically motivated theory of first and second language. In B. VanPatten, & J. Williams (Eds.), *Theories in second language acquisition: An introduction* (pp. 135–158). Routledge.
- Vereeck, A., Bracke, E., De Herdt, K., & Janse, M. (2023). *Revered and reviled. An outline of the public debate regarding classical language education*. Manuscript in preparation.
- Vereeck, A., Janse, M., De Herdt, K., Hauspie, C., Szmalec, A., & Woumans, E. (2023). *Does studying Latin make pupils smarter? Presenting the field of classical language impact studies*. Manuscript in preparation.
- Vereeck, A., Janse, M., De Herdt, K., Szmalec, A., Hauspie, C., & Duyck, W. (2022). A debate in need of data: Report of an empirical study on the cognitive transfer effects of studying classical languages [Conference presentation abstract]. In M. Jurišević (Ed.), *Book of Abstracts: 17th European Congress of Psychology. Horizons of Psychology*, 31, 59–447.
- von Bastian, C., & Oberauer, K. (2014). Effects and mechanisms of working memory training: A review. *Psychological Research*, 78(6), 803–820.
- Woumans, E., Surmont, J., Struys, E., & Duyck, W. (2016). The longitudinal effect of bilingual immersion schooling on cognitive control and intelligence. *Language Learning*, 66(2), 76–91.