INTRODUCTION

# What is a verb?

## Linguistic, psycholinguistic and developmental perspectives on verbs in Germanic and Semitic languages

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Verbs constitute one of the basic building blocks of a clause, setting the structure of arguments and expressing the relationships among nouns in various thematic roles. In general terms, verbs are lexical items expressing verb-oriented notions such as activities, processes, and states. In morphology-rich languages, the syntactic and lexical roles of verbs are mediated by typologically-oriented morphological means. The current Special Issue contrasts the structure and functions of verbs in languages from two morphologically rich, yet typologically different families. The articles in the Special Issue present spoken and written aspects of verbs in usage and development in German (a Germanic language) on the one hand, in Hebrew, Neo-Aramaic, and Arabic (Semitic languages), on the other. From a theoretical linguistic perspective, we ask how the different typological features of these languages affect the function of verbs in sentences, and from a psycholinguistic perspective, we ask how typological differences affect the processing of verbs in the mature minds of adults and in the developing minds of children.

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Up to 10–15 years ago, psycholinguistic research on morphological processing lived well with the distinction between modern Indo-European and Semitic languages. The linearity of the morphological units that build the words within a language was assumed the key differentiating factor, with Indo-European languages representing linear (concatenative) word formation where prefixes and suffixes are attached to a stem, and Semitic languages representing nonlinear

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(nonconcatenative) word formation, where root consonants are intertwined with a prosodic pattern. This linearity distinction served to explain several behavioral findings where native speakers of Semitic languages typically parse a word into its root and word pattern, irrespective of the word's meaning (Boudelaa & Marslen-Wilson, 2004; Frost, Deutsch, & Forster, 2000; Frost, Forster, & Deutsch, 1997). In contrast, native speakers of contemporary Indo-European languages like English and French were found to parse a word into its stem and affix only if the whole-word meaning is compositional so that it can be assembled from the meaning of its parts (Marslen-Wilson, Tyler, Waksler, & Older, 1994; Meunier & Longtin, 2007; Rastle, Davis, Marslen-Wilson, & Tyler, 2000).

This distinction became blurred when native speakers of German showed behavioral patterns similar to the ones in Hebrew and Arabic, parsing words into constituents regardless of their whole-word meaning (Smolka, Komlósi, & Rösler, 2009; Smolka, Preller, & Eulitz, 2014; Smolka, Gondan, & Rösler, 2015). Hence, the question that arose was why German should trigger language processing similar to that in Semitic languages. Ensuing this question, we organized several international workshops to discuss the typological characteristics of languages from different language families and their effects on language processing. In what follows, we summarize some of the typological features that may yield similar typical effects in German and Semitic languages.

## What makes Semitic and Germanic languages 'morphologically rich'?

One of these typological features is morphological richness. Here, we consider three typological features that characterize a language as 'morphologically rich', with implications for language processing and language acquisition (Ravid, 2003, 2012; Saiegh-Haddad, 2018; Xanthos et al., 2011).

First, 'rich' morphology encodes many semantic notions – both inflectional and derivational – in word-internal format. For example, a Hebrew verb such as *hidlakt* 'you fem. lit' encodes the notions of lighting (root *d-l-k*), transitivity (verb pattern *Hif'il*), past tense (prefix *h-*, pattern vowels), and second person, singular, feminine (suffix *-t*). In a similar way, a German verb such as *anzündetest* 'you sg. lit' encodes the notions of lighting (particle *an* 'on, at' + stem *zünd* 'light'), past tense (suffix *-te*), and second person, singular (suffix *-st).* Children growing up in morphology-oriented languages must learn to seek meaning within the word, arriving at the full processing potential in adulthood.

A second property of 'rich morphology' is systemic in nature. Semitic morphology is rich in the *systemic* sense, as it uses at least two major structural systems to encode morphological notions – a linear and a nonlinear one. Linear

(concatenative) morphology aligns affixes to word stems, similar to word derivation in English and German, such as the agentive Arabic suffix *-ji* that derives Arabic *busta:n-ji* 'gardener' from *busta:n* 'garden'. In a similar way, Hebrew attaches the agentive suffix *-ay* to *iton* 'newspaper' to derive *iton-ay* 'journalist'. While prevalent as an inflectional device expressing person, number and gender agreement, linear morphology is restricted in Hebrew derivation to nominals, and is thus a later acquisition typical of the school years (Ravid, 2006). In contrast, nonlinear (nonconcatenative) morphology is the major structural device organizing the Semitic lexicon through the affixation of two sub-lexical morphological primes – the Semitic *root* and the prosodic *pattern*, complementary morphemes, which intertwine to make up the Semitic stem (Berman, 2012; Schwarzwald, 2000). For example, the Arabic root *k-b-r* intertwined with two different word patterns yields the Arabic adjective *kbi:r* 'big' and the verb *kiber* 'grow, become big'; and the Hebrew root *l-m-d*, intertwined with different word patterns yields the Hebrew verb *limed* 'teach' and noun *talmid* 'student'. Root-and-pattern (nonconcatenative) morphology constitutes the Semitic highway to word-formation by roots connecting clusters of words with shared consonantal skeletons and lexical reference, as well as by morphological patterns grouping together words with the same prosodic structure and shared categorial class. For example, the Hebrew pattern *CaCuC* derives passive resultative adjectives such as *gazur* 'cut (by scissors)', *katuv* 'written', or *gamur* 'finished/done' (Berman, 1994). Thus, Semitic words fall into a small number of categories containing similar, tightly linked morphemes, conveying salient lexical semantics, with strong internal associations (Bar-On & Ravid, 2011; Levie, Ben-Zvi & Ravid, 2017; Ravid & Schiff, 2006). These features make the root-and-pattern system highly learnable from early on (Berman, 1985; Ravid, 2003), and consequently render it a leading organizational factor in the core lexicon of Semitic languages (Ravid et al., 2016).

German is considered to possess a linear (concatenative) morphology for word inflections and derivations (Eisenberg, 2004). For example, the German suffix *-er* derives agentive nouns, such as *Lehrer* 'teacher' from the verb *lehren* 'to teach'; and the suffix *-keit* derives abstract nouns from adjectives, such as *Freundlichkeit* 'friendliness' from the adjective *freundlich* 'friendly', which itself is derived from the noun *Freund* 'friend' by the suffix *-lich*. At the same time, German does possess some nonlinear (nonconcatentive) elements as well. For example, most compounds contain *Fugenelemente* 'interfixes' (Wegener, 2003); and, comparable to the root within a word pattern, the root/stem of German particle verbs occurs in different positions, compare *anzünden* ('to light'), *angezündet* 'lit, past participle', *anzuzünden* 'to be lit', and *zündet an* 's/he sg. lights'. For details see Smolka, Libben, & Dressler (2019).

Consequently, children acquiring Semitic and Germanic languages experience their morphology in terms of a systematic, complex apparatus and learn to use morphological structures as pointers to word category and possible meaning.

A final property of rich morphology expressed in both Semitic and German morphology involves many morpho-phonological changes within the word and the root. For example, under morphological operations, Hebrew roots undergo changes such as stop/spirant alternation, as demonstrated in the temporal declension of *katav – kotev – yixtov* 'wrote – is writing – will write', based on the root *k-t-b*. Though to a lesser degree, such morpho-phonological changes occur in German as well, including not only the verb and plural inflections but also derivations. For example, the vowels of the root *werf* 'throw' alternate in the temporal declension *werfen – warf – geworfen* 'throw – threw – thrown', in 2nd and 3rd person singular indicative *wirfst* 'you sg. throw' and *wirft* 'throws', and in all conjunctive forms, such as *würfe* 'I throw, conj.' . Morpho-phonological stem changes typically occur also in plural formation, as in *Apfel – Äpfel* 'apple – apples', *Baum – Bäume* 'tree – trees', and *Duft – Düfte* 'scent – scents'; and in derivations, such as *Käufer* 'customer' and *käuflich* 'purchasable' derived from the verb *kaufen* 'buy'. Children growing up in a language where morphemes keep changing form, yet systematically retain the same meaning, learn to look for patterns of complex relationships between meaning and structure.

To summarize, some Germanic and Semitic languages show characteristics typical of morphologically rich languages in that they are (a) synthetic (i.e. using many morphemes to express meaning), (b) systematically nonconcatenative (i.e. nonlinear), and (c) include morpho-phonological root/stem alternations.

## Why focus on verbs?

The current Special Issue revolves around verbs in linguistic and psycholinguistic perspectives. The question "What is a verb?" has long challenged linguistic and psycholinguistic research. In contrast to the noun, the verb is assumed to be more abstract, encoding temporal notions, conveying relations between referents (i.e., subjects, objects) – thus 'optimizing' noun reference (Eisenberg, 2004). Hence, verbs constitute a basic building block in the clause, setting the structure of arguments and expressing the relationships among nouns in various thematic roles. Consequently, in language acquisition, verbs are viewed as an "architectural centerpiece" of grammar and its acquisition (Golinkoff & Hirsh Pasek, 2008: 4). From a lexical-semantic point of view, verbs are lexical items expressing verb-oriented notions such as activities, processes, and states. In morphology-rich languages, these syntactic and lexical roles of verbs are mediated by typologically-

oriented morphological means (D'Odorico et al., 2001; Nichols, 2016). Importantly for the topic of the current Special Issue, morphological systematicity has been shown to operate in both spoken and written modalities, with different issues involved in its spoken and orthographic manifestations (Bar-Kochva & Hasselhorn, 2017; Frost, 2012; Gumnior, Bölte, & Zwitserlood, 2006; Ravid, 2012). Thus, for example, acquiring spoken Hebrew verb morphology in early childhood involves paying attention to repeating consonantal skeletons in words and to the systematic alternation of vowel templates (*binyan* patterns) in their environment. In contrast, written Hebrew morphology has a critical role in the developmental trajectory of construing the root and pattern as abstract concepts, since the non-vowelled nature of Hebrew orthography renders root letters highly prominent while patterns are recognizable mostly by their affixes. Thus, non-linear morphology presents different challenges to spoken and written processing.

In the current Special Issue we are interested in contrasting verbs and their morphological components in German (a representative of the West-Germanic languages) on the one hand, and Semitic languages (Hebrew, Neo-Aramaic, and Arabic) on the other. From a theoretical linguistic perspective, we ask how the different typological features of these languages affect the function of verbs in sentences, and from a psycholinguistic perspective, we ask how typological differences affect the processing of spoken and written verbs in the mature minds of adults and in the recognition of spoken verbs in the developing minds of children. Interestingly, psycholinguistic (rather than developmental) research that deals particularly on verbs is rather sparse, as we elaborate below.

## Semitic verb morphology

Semitic lexicons contain two major lexical classes, based on morphological, semantic, and syntactic criteria. One is Nominals, with ontological semantics and nominal structures, including nouns, derived nominals, and adjectives. Another is Verbs, with verb-oriented semantics and dedicated morphological devices (Ravid, 2019a).

Verb morphology in Semitic languages is composed of root and pattern structure both inflectionally, within the paradigm of a single verb pattern (termed *binyan*); and derivationally, across different *binyan* patterns (Bolozky, 1999). As a consonantal, discontinuous entity, the Semitic root is not pronounceable, and as a sub-lexical bound morpheme, it has no lexical category. It is always complemented by the verb *pattern,* providing the prosodic template which determines the basic morpho-phonology of verb stems, including root radical slots, vowel combinations and stress assignment, and affixes in some cases (Ravid, 2003).

Semitic verbs constitute the most typical habitat of root-and-pattern morphology, expressing the full range of verb-oriented meanings of activities, events, processes, and states by a sole device – the non-linear affixation of roots to seven *binyan* patterns traditionally termed *Qal, Nif'al, Hif'il, Huf'al, Pi'el, Pu'al,* and *Hitpa'el* respectively. Beyond their prosodic contribution to Semitic morphology, *binyan* patterns are associated with verb argument structures, relating them to syntactic-semantic valency functions such as causativity, inchoativity, reciprocity, reflexivity, and voice. The particular lexical meaning of the combination of a *binyan* with a specific root, the size and internal composition of derivational verb families are all semi-predictable – so that the finer-grained information on Semitic verb lexical semantics needs to be learned for each verb lemma in context (Berman, 1988; Ravid, 1990; Ravid et al., 2016).

From a derivational perspective, each Semitic verb lemma is a unique combination of a root in a specific *binyan,* with all verb lemmas based on the same root taking one of the seven *binaynim*, creating root-based and *binyan*-based morphological verb families. Root-based families are exemplified by the Arabic root *k-s-r,* which, intertwined with different word patterns, yields the verbs *kasar* 'break (transitive)', *inkasar* 'break (intransitive)', and *kassar* 'break into pieces (transitive)'. In the same way, the Hebrew root *k-n-s* meaning 'come-in, enter' relates the following verbs, each in a different *binyan*, in a single root-based family: *nixnas* 'come-in, enter', *hixnis* 'put in, insert', *huxnas* 'be inserted', *kines* 'assemble (trans.)', *kunas* 'be assembled', and *hitkanes* 'assemble (intr.)'. A family based on the same *binyan* is illustrated by all of the following verbs, each with a different root: *hixnis* 'put in, insert', *hizmin* 'invite, reserve', *hit'im* 'match', and *hiklit* 'record'.

Non-linear morphology extends from derivation to inflection as well. From an inflectional point of view, each *binyan* comprises a bundle of temporal patterns which combine with a single root to express past, present, and future tense, imperative mood, and infinitive form (Ashkenazi, Gillis & Ravid, in press; Ravid et al., 2016). For example, the verb meaning 'knit' from root *s-r-g* in *Qal* yields past tense *sarag*, present tense *soreg*, future *yisrog,* imperative *srog,* and infinitive *lisrog.*

As a result of this systematic configuration across derivation and inflection, both roots and *binyan* patterns organize the Semitic verb lexicon and serve as the platform for the derivation of new verbs, packaging verb-oriented semantics and syntactic verb-argument valency.

## Germanic verb morphology

The German verb conjugation system is highly inflected, indicating person, number, tense, and mode (indicative/conjunctive/imperative) by means of

suffixes, prefix *ge-* (combined with the suffix *-t/en* in the past particle formation), as well as stem vowel alternations ('Ablaut') for most subregular and 'strong'/'irregular' verbs (Eisenberg, 2004; Wiese, 1996). Importantly, the surface form of a German verb allows no prediction as to whether a verb is inflected in a regular, subregular or irregular way (Durrell, 2001; Smolka, Zwitserlood, & Rösler, 2007).

In contrast to verb inflection, verb derivation in German is dominated by the very productive process of prefixation (Eisenberg, 2004), analogous to that of suffixation. For example, the prefix *ent-* derives verbs from nouns (e.g., *entstauben*, 'dust off' from *Staub* 'dust'), from adjectives (e.g., *entmutigen*, 'demotivate' from *mutig*, 'brave') as well as verbs from verbs (*entlaufen* 'run away' from *laufen* 'run'). The linguistic literature (Eisenberg, 2004; Fleischer & Barz, 1992; Olsen, 1996) distinguishes two word formations: prefixed verbs and particle verbs, respectively consisting of a verbal root and a verbal prefix or a particle. According to Eisenberg (2004), the core verbal prefixes are bound morphemes that do not necessarily possess lexical meaning, *be-, ent-, er-, ver-, zer-*, and five prepositional prefixes that are homonyms with particles and thus have lexical meaning (e.g., *durch* 'through', *hinter* 'behind', *über* 'above', *um* 'around', *unter* 'under'). In contrast to the limited number of verbal prefixes, the number of verbal particles is extremely high, since they are free morphemes in the function of prepositions or adverbs, such as *an* 'at', *auf* 'on', *ab* 'off', *ein* 'into', *nach* 'after', *vor* 'before', *mit* 'with', *um* 'around', *zurück* 'back.'

The same verbal root can build up morphological families with up to 135 family members. In fact, we are not aware of a verbal root that does not yield any derivation.[1] Some verbs like *herrschen* 'govern' build relatively small families: *beherrschen* 'rule', *anherrschen* 'bark at so.', and *vorherrschen* 'predominate'. By contrast, the verb *gehen* ('go') has the considerable family size of 135 complex verb derivations. In between these two extremes, we find many verbs with 15 to 50 family members, such as the verb *kehren* 'sweep': *abkehren* 'sweep off', 'turn away', *aufkehren* 'sweep and collect on a shovel', *auskehren* 'sweep', *bekehren* 'convert', *einkehren* 'stop for a bite to eat', *heimkehren* 'return home', *hervorkehren* 'disclose', *umkehren* 'turn around', *verkehren* 'consort', *vorkehren* 'precaution', *wegkehren* 'sweep away'. As these examples show, the meaning of the verb derivations may vary considerably with respect to the meaning of the base verb.

Likewise, the same prefix or particle may drastically alter the meaning of the complex verb from relatively transparent on one end of the continuum to relatively opaque on the other end of the continuum of compositionality. For example, the particle *auf* 'on, to, up' only slightly alters the meaning of the base

1. In fact, even recent borrowings like *faxen* 'fax' can be productively combined with a particle, as in *zurückfaxen* 'return by fax'.

*stehen* 'stand' in the derivation *aufstehen* 'stand up', but radically does so in the derivation *aufhören* 'stop' with respect to its base *hören* 'hear'. Similarly, the prefix *ver-* produces the relatively transparent derivation *verhören* 'misunderstand, interrogate' as well as the opaque derivation *verstehen* 'understand'.

Prefix and particle verbs show some prosodic and morpho-syntactic differences (see Smolka et al., 2019). For example, the former carry the main word stress on the stem (*umSTELLEN*), the latter on the particle (*UMstellen*). Verbal prefixes are inseparable from their base (*Truppen umSTELLEN das Gebäude*, 'Troops surround the building'), while particles are separated from the verb stem in finite forms (*Sie stellen die Stühle UM*, 'They relocate the chairs'). Moreover, the *ge-* prefix in participle formation is substituted in prefix verbs (*umstellt* 'surrounded'), and enclosed in particle verbs (*umgestellt* 'relocated'); and in infinitive formations, the particle *zu* 'to' appears before the prefix verb (*zu umSTELLEN*) and is enclosed in the particle verb (*UMzustellen*). Despite these distinctive prosodic and morphosyntactic characteristics, prefix and particle verbs share similar semantic properties in that both can be transparently and opaquely related to the meaning of their root/stem.

Apart from these distinctive prosodic and morphosyntactic characteristics, the distinction between prefix and particle verbs is not unequivocal among linguists (Eisenberg, 2004; Lüdeling & De Jong, 2001; Olsen, 1996), and rather suggests that they share some formal and functional similarities. Moreover, behavioral effects of prefix and particle verbs were found to be alike in both German (Drews, Zwitserlood, & Neuwinger, 2000; Smolka et al., 2019) and Dutch (Schriefers, Zwitserlood, & Roelofs, 1991). Henceforth, we combine them under the term 'complex verbs'.

## Psycholinguistic perspectives of Semitic and Germanic verb processing

Most psycholinguistic (in contrast to *developmental* psycholinguistic) research has so far revolved around the processing of nouns and adjectives, far less specifically around verbs. Against this background, we take two perspectives on verbs in this Special Issue, with typology as the linking factor. One is psycholinguistic in nature, focusing on the processing of verbs in their syntactic and pragmatic environments. Another is developmental, in the sense of examining the challenges verbs present to children in acquisition and the role morphology and its semantics play in gaining command of the verb system. The studies in this Special Issue examine Hebrew, Arabic, and German, exploring the typological factors that influence both verb learning and verb processing in these languages. The focus of the Special Issue is not on the well-known dispute regarding the status of verbs

(and nouns) with regular versus irregular inflections (Diessel, 2015; Tatsumi & Pine, 2016), but rather on the processing and learning of complex verb meaning and valency functions.

In general, verb processing differs from that of other word categories. For example, semantic associations between nouns (*honey – bee*) and adjectives (*black – white*) typically produce robust behavioral priming and N400 electrophysiological (EEG) effects (Domínguez, de Vega, & Barber, 2004; Gonnerman, Seidenberg, & Andersen, 2007; Kielar & Joanisse, 2011; Marslen-Wilson et al., 1994). In contrast, semantic associations between verbs (e.g., *suchen – finden* 'search – find', *nahen – kommen* 'approach – come') are difficult to detect in behavioral priming studies and sometimes surface only when brain potentials are directly measured by means of EEG (Smolka, Gondan, & Rösler, 2015; Smolka, Khader, Wiese, Zwitserlood, & Rösler, 2013).

In the following, we relate to all types of verbs, be they Hebrew, Arabic or German as constituting complex verb stems – root and a *binyan* in the former, root and a prefix/particle in the latter.

## Access to the verbal root

One fundamental question on verb acquisition and usage concerns the lexical component of the verb – the root (both in Hebrew/Arabic and in German). To what extent are verbs in morphological families constructed on the basis of roots which carry a shared meaning (and structure), as in *gadal* 'grow', *higdil* 'enlarge', *gidel* 'raise', and *hitgadel* 'aggrandize oneself', all based on the root *g-d-l*? Or is it the case that the root is an emergent property of the verb which manifests itself as a by-product of learning the verb system, deriving its meaning from the aggregation of verbs in the morphological family (Ravid, 2019a)?

A seminal masked priming experiment revealed root priming by verbs holding the same root such as *l-b-š* in different *binyanim*, such as *hitlabesh – hilbish* 'dress, reflexive – dress, Trans.' (see Example 3 in Deutsch, Frost, & Forster, 1998). These findings, together with other findings on nouns, were interpreted to indicate that the root and the word pattern are abstract units that are obligatorily extracted by speakers of Semitic languages, both in written text (Deutsch et al., 1998; Frost, Deutsch, & Forster, 2000) and in spoken language (Boudelaa & Marslen-Wilson, 2004; Frost, Deutsch, Gilboa, Tannenbaum, & Marslen-Wilson, 2000).

Interestingly, such root priming has been repeatedly found in German as well. Root priming is observed to be independent of the meaning of the complex verb, since it occurs in verbs with both compositional meaning, such as *zuhören* –

*hören* 'listen to – hear', and compositional meaning, such as *aufhören – hören* 'stop – hear', and even in verbs with bound stems such as **dauen – verdauen* 'digest' (Schirmeier, Derwing, & Libben, 2004; Smolka et al., 2015; Smolka et al., 2009; Smolka et al., 2014). Root priming was found to be independent of modality, as it was also obtained under spoken language processing (Smolka this volume; Smolka et al., 2019; Smolka et al., 2014). Root priming was further found to be independent of syntactic and prosodic features of the verb, since it occurs in both prefix and particle verbs (Smolka et al., 2019). Root priming without effects of semantic compositionality has been replicated in several priming and speech production experiments in Dutch, which is a closely related language with a highly similar system of verbal prefixes, separable particles, and non-separable particles (Cremeer, Goodwin, Wilder, Tamminga, & Embick, 2019; de Grauwe, Lemhöfer, & Schriefers, 2019; Roelofs & Meyer, 1998).

However, root priming in German and Dutch contrasts with findings in other Indo-European languages. In English and French, only compositional words like *regain* and *underwork* yield root priming, but not noncompositional words like *rehearse* and *understand* (Bozic, Tyler, Su, Wingfield, & Marslen-Wilson, 2013; Feldman & Soltano, 1999; Feldman, Soltano, Pastizzo, & Francis, 2004; Gonnerman et al., 2007; Kielar & Joanisse, 2011; Marslen-Wilson et al., 1994; Meunier & Longtin, 2007; Rastle et al., 2000). Thus, results for Hebrew, Arabic, German and Dutch on the one hand and results for English and French on the other hand appear at present to be genuinely irreconcilable. A recent computational model has shown that the different behavioral patterns that we observe for English and German are grounded in the different structure of these languages (Günther, Smolka, & Marelli, 2019). It seems that morphological richness (or sparsity) may serve as a good explanatory factor in differentiating between languages that do or do not show root priming (independent of meaning and composition) (Plaut & Gonnerman, 2000; Smolka et al., 2009).

## Argument structure and valency of verbs

Another important question relates to the role of the *binyanim* – the verb patterns organizing root-sharing morphological families – in terms of transitivity values and *Aktionsart*. In traditional Hebrew perspective, which has extended to the developmental psycholinguistic literature, *binyanim* categorize verbs into high and low transitivity groups, such as poorly transitive *Nif'al* and *Hitpa'el*, versus highly transitive *Pi'el* and *Hif'il*. *Binyanim* further categorize verbs by their semantic-functional values such as causative, inchoative, reflexive or reciprocal, as demonstrated by the morphological family of the root *g-d-l* 'grow' above, with

two causatives ('enlarge' and 'raise') and two inchoatives ('grow' and 'aggrandize oneself').

In contrast to word patterns of nouns, the *binyan* patterns of verbs seem to possess a strong meaning representation by themselves. In two masked priming experiments Deutsch et al. (1998) observed that Hebrew verbs holding the same *binyan* pattern but different roots induced priming (e.g. *huklat – hugdar* 'be recorded – be expanded'), even when the combination of the verbal pattern with the root does not exist (**higmir – hilbish* '*make finish – dress, Trans.'). A similar finding of *binyan* priming was obtained in Arabic, where verbs with the same verbal pattern but different roots induced priming (e.g. *?ittahada – ?ibtasma*, 'unite – smile') (Experiment 2 in Boudelaa & Marslen-Wilson, 2004). The *binyan* system should thus be more closely investigated for two critical properties. One is its composition in terms of argument structure and adjuncts in relation to the *binyanim* (Dattner, 2015). Another involves the alignment of verbs in morphological families according to the grouping of *binyan* verb patterns expressing syntactico-semantic functions (Ravid, 2019a). Where these analyses are anchored in naturalistic corpora, each verb token can be studied in its syntactic and discursive context (Dattner, 2019).

In German too, verbs specify the argument structure in the clause and express transitivity relations. For example, the valency of the verb determines the number of arguments that a sentence requires (e.g., in the German correspondents of *It rains* vs. *He gives her*$_{object_1}$ *a present*$_{object_2}$). The number of arguments (and the valency) of German verbs was shown to affect the visual processing of passive sentences (Dörre & Smolka, 2019), where ditransitive verbs (i.e. holding two arguments) in sentences such as *[Ihr* $_{object_1}$*] wurden von ihm [die Haare* $_{object_2}$*] gewaschen* 'her hair was washed by him' show a processing advantage over transitive verbs (i.e. holding one argument) in sentences such as *[Nach den Bonbons* $_{object_1}$*] wurde von ihr gegriffen* 'for the sweets was reached by her'.

## Developmental psycholinguistic aspects of verbs

From a lexical perspective, early verb development in Hebrew is very similar to what has been reported in many other languages (Slobin, 1985). From a morphological point of view, the acquisitional path of Semitic verbs has been the focus of considerable research as a major habitat of non-linear (nonconcatenative) morphology (McCarthy, 1981). To date, several studies have focused on Hebrew verbs, roots and *binyanim* as key in morpho-lexical and grammatical development, in typically developing as well as in language-impaired children and children from low Socio-Economic Status (Levie, Ben Zvi & Ravid, 2017).

A specific challenge in learning about Semitic roots is gaining command of their structural variety. Hebrew roots are classified as either full (or regular), such as *g-d-l* 'grow' or *s-r-g* 'knit', expressing all of their root radicals in every inflectional and derivational context, or defective (or irregular) roots, such as *n-t-n* 'give' or *b-w-?* 'come', where one or two of the root radicals does not surface in certain morphological contexts. Regular roots fit into the *binyan* templates, resulting in transparent verb forms (e.g., *yigdal, yisrog* in future tense), whereas irregular roots distort the form of the verb, resulting in opaque forms (e.g., *yiten, yavo* in future tense (Ravid, 2019a; Ravid et al., 2016). In a dense study relating children's speech and the input of their parents between the ages of 1;8–2;2, Ashkenazi (2015; Ashkenazi, Ravid & Gillis, 2016; Ashkenazi, Gillis & Ravid, in press) showed that children's output greatly resembled parental input in terms of distributions of root types, with a high token frequency of irregular roots in both Child Directed Speech (CDS) and Child Speech (CS). These findings can be used to evaluate the development of the verb lexicon in Hebrew, as the small number of irregular roots is mastered early on, leaving the bulk of lexical acquisition to verbs with regular roots.

A related challenge facing children acquiring Semitic languages is "breaking into the system", that is, learning about the morphological components making up the Hebrew verb and how they are aligned. Lustigman (2012) investigated the development of early verb inflections in a corpus of four toddlers aged 1;4–2;2 in the context of Berman's phase model (1986). She found that Hebrew speaking children use bare stems as their initial verb forms, while prefix marked full infinitives occur later, in well-formed syntactic contexts, alongside the productive use of affixed present tense participle forms. Ashkenazi's (2015) study showed that the structural opacity of verbs with irregular roots that are prevalent in child speech and in the input by parents is mitigated by the frequency of modal verbs in future, imperative and infinitive forms. Ashkenazi et al. (2016) showed that toddlers "break into the system" by attending to the clear affix boundaries highlighting the varying inner structure of the verb as a form of non-adjacent dependency (Sandoval & Gómez, 2013). Importantly, Ashkenazi et al. (in press) showed that the increasing richness and complexity of inflectional morphology in the growing lexicons of Hebrew-speaking children are linked to their increasing complexity of derivational expression and to the growth of the regular root component in the verb lexicon.

Another challenge in Semitic verb learning is acquiring the complex *binyan* system as a derivational system and as a morphological marker of verb transitivity. In a series of seminal studies, Berman (1993a,b,) defined two major verb-oriented 'scripts': active, transitive and/or causative events, expressed through *Pi'el* or *Hif'il*, versus passive, intransitive reflexive or reciprocal and/or middle or inchoa-

tive expressed through *Nif'al* and *Hitpa'el*. In a study of the first 20 verbs in toddlers aged 1;2–2;1, at the one word stage, no alternations appeared between different *binyanim* of the same root (Armon Lotem & Berman, 2003). Berman's studies showed a sharp rise in marking transitivity alternations at ages 3–4, and creative errors in children's spontaneous usage at ages 4–5, as evidenced by lexical innovations mostly within the pair of *binyan* patterns expressing the same script.

From a different perspective, Ravid and colleagues (2019a; Ashkenazi, Gillis & Ravid, in press; Levie et al., under review) showed that the Hebrew *binyan* system falls into two sub-systems – the older sub-system of *Qal, Nif'al, Hif'il, Huf'al,* with a large type and token frequency, especially in early childhood; and *Pi'el, Pu'al* and *Hitpa'el*, productively generating the overwhelming majority of new verbs, especially in literate Hebrew users. Each of the sub-systems autonomously expresses all of the transitivity and Aktionsart relationships, with links forming across sub-systems to express the rich, variegated verb lexicon of Hebrew. Studying the *binyan* system in developmental perspective can benefit from the implications of the changing distributions of *binyan* patterns. One recent finding (Ashkenazi et al., in press; Levie et al., under review) is that most of the verbs in young verb lexicons are singletons, that is, they do not share roots with other verbs, and most of the root-based verb families are small, with two *binyanim* only, e.g., *nirdam / hirdim* 'fall asleep / make sleep'. Moreover, the two-*binyan* families in the smaller and less developed verb lexicons of children exist mostly within one or two of the sub-systems, whereas richer, complex verb lexicons of adolescents and adults also contain some larger verb families that are shared across the two sub-systems. These findings can be used to make predictions about the course of acquisition of verbs in Hebrew.

In German, root priming points to the psycholinguistic status of roots in children. A study testing 165 schoolaged children (Smolka & Baayen, in prep.) showed a developmental trajectory in root facilitation: In children aged 11–12 opaque verbs like *ertragen – tragen* 'suffer – carry' facilitated roots to a lesser degree than did transparent verbs like *beleuchten – leuchten* 'illuminate – glow'. In contrast, older children aged 14–15 showed the patterns of the adolescent mind: stem facilitation without any effects of semantic transparency. These findings indicate that children require time and language exposure to learn that many complex verbs hold the same base. That is, stem access is an acquired feature of the developing brain (Ravid, 2019b). This fits in with the observation that young children prefer semantic transparency more than adults in the production of German diminutives (Dressler et al. 2018).

With respect to verbal derivations, (Behrens, 1998) reported in a seminal study that in English and Dutch, prefix and particle verbs are acquired at the same age. However, German verbs with separable particles (e.g., *ab-werfen* 'throw off')

are acquired earlier on and represent a large portion of a child's general verb use, while prefix verbs (e.g., *be-werfen* 'throw at') are acquired later on. These findings are supported by age of acquisition estimates (Smolka & Eulitz, 2018) and Dressler and colleagues, who observed that particle verbs are initially acquired before prefix verbs and that particle verbs emerge, due to prosodic and positional salience, first as particles only, that is, *auf* 'up' for *aufmachen* 'to open, lit. up+make' or the imperative *mach auf*! similar to Dutch (Klampfer, 2003).

Given this review of the psycholinguistic status of verbs and their morphological components in German versus Hebrew and Arabic, the current Special Issue comprises six articles presenting new linguistic and psycholinguistic work on verbs. The Special Issue starts with a linguistic contribution by Ariel Gutman on the verbal system of the Jewish Neo-Aramaic dialect of Zakho. Ariel Gutman differentiates between linguistic analysis and the language use by native speakers and concludes that the pronominal affixes and agreement markers are not distinct but rather fluid categories in the language use of Zakho.

In the second linguistic paper, Lior Laks, Ibrahim Hamad and Elinor Saiegh-Haddad examine the verbal system of Palestinian Arabic. They analyze the spoken language of native adult speakers according to the distribution of roots, verbal patterns and transitivity and show surprising results with respect to the actual usage of verbal patterns and their semantic and syntactic functions.

The developmental trajectories of Hebrew verbs are taken up by Ronit Levie, Elitzur Dattner, Racheli Zwilling, Hadas Rosenstein, Shirly Eitan Stanzas and Dorit Ravid who analyze the impact of low Socioeconomic Status (SES) on verb processing in Hebrew speaking children. They apply a novel method – network analysis – to investigate the speech of 4 to 6 year old children and find that the socioeconomic status of these children strongly affects both quantity (size) and quality (elaborateness of verbal patterns) of their verbal system.

Veronika Mattes describes how German speaking children disambiguate polyfunctional verbal prefixes in German. She examines how pre-schoolers, second and fourth grade school children respond to existing and novel combinations of verbal prefixes and verb stems. She shows the developmental trajectories for both the prefix and stem usage and concludes that verbal derivation patterns are not fully mastered until adulthood.

The next article deals with the question of how adults process complex verbs in German. Eva Smolka applies cross-modal priming experiments to differentiate between stem access and stem meaning and finds that, upon hearing a particle verb, adult native speakers do access the stem but do not retrieve the stem's meaning, thus indicating a difference between lexical processing and lexical meaning representation.

The Special Issue ends with the linguistic paper by Augustin Speyer who reflects upon the function of a verb in German sentences, that is, a verb's syntactic perspectives. He uses text corpora to study the canonical verb positioning in different sentence modes and finds that, in German, different sentence types are marked by different verb positions.

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