



# The Direct and Indirect Relations Between Self-Regulation and Language Development Among Monolinguals and Dual Language Learners

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## Abstract

In this review, we expand the conversation on the relations between self-regulation and language development in early childhood to include the growing population of dual language learners (DLLs). In the first sections, we highlight similarities in the timing and mechanisms of self-regulation and language development, respectively, and then summarize theoretical and empirical literature on the domains' joint development. We ground this review in a conceptual model of the direct and indirect relations between skills in the two domains. In terms of direct relations, language facilitates mental organization and representation of self-regulation, whereas self-regulation allows children to capitalize on language-learning opportunities. Indirectly, self-regulation and language are related through shared ecological contexts of development. Throughout, we evaluate the applicability of our conceptual model among DLLs in light of evidence that: (1) language background is associated with unique contextual realities with implications for development in both domains, and (2) contemporary methodological approaches often fail to accurately capture DLLs' skills in either domain. We present recommendations for future research on the relation between self-regulation and language that take into account these distinct considerations for DLLs.

**Keywords** Self-regulation · Language · Cross-domain development · Dual language learners

In the first five years of life, young children make remarkable advances in regulating thoughts, emotions, and behaviors and using language as a communicative tool. Competencies in these two domains—self-regulation and language—lay the groundwork for later development in other domains and are critical for success in school and life (Best and Miller 2010; Dickinson and Tabors 2001). Given their importance, much work has sought to determine how skills in either the self-regulation or language domain drive development in the other during this period of rapid growth. On the one hand, language skills can facilitate self-regulation by serving as a cognitive tool to comprehend and plan one's own behavior (Valotton and Ayoub 2011; Vygotsky 1986). On the other hand, self-regulation skills can encourage language, as well-regulated children effectively capitalize on informal and formal language-learning opportunities and readily apply the

complex rules of language (Bohlmann and Downer 2016; Colé et al. 2014). These interdependencies between self-regulation and language have implications for supporting children's development in either domain. Co-occurring patterns of risk or strength in self-regulation and language skills suggest that targeting skills in one domain is likely to have spillover effects on skills in the other (Salmon et al. 2016).

Despite a wealth of research linking self-regulation and language, most of the extant literature has focused on English-speaking monolingual children, leaving the relation between self-regulation and language skills for dual language learners (DLLs) less understood. This gap is important to address for several reasons. First, DLLs—who we define as children who speak only or primarily a minority language at home and are in the process of learning more than one language—represent close to one-third of preschool-aged children in the USA (Child Trends 2014) and the proportion of DLLs in schools across the country is expanding (U.S. Department of Education 2011). As such, any general understanding of developmental processes must include this population. Second, research comparing DLLs and monolinguals has found average advantages in

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self-regulation skills and disadvantages in language skills among DLLs (Bialystok 2009), suggesting that we should not assume the same co-occurring developmental patterns of self-regulation and language skills among DLLs that we observe among monolinguals. Third, given the role of environmental features in shaping children's development in both domains, the distinct linguistic and social contexts of DLLs may uniquely affect self-regulation and language's joint development.

In this paper, we review the state of research on the connection between self-regulation and language development in early childhood with a particular focus on DLLs. This allows us to consider whether DLLs' unique environmental realities influence the joint development of self-regulation and language. We begin by providing a brief overview of self-regulation and language development among all typically developing children, highlighting the domains' developmental parallels. This provides the foundation for our subsequent review of the theoretical and empirical literature on the relation between self-regulation and language development. We ground this review in a conceptual model of the direct and indirect relations between skills in the two domains. Throughout, we consider the relevance of this model among DLLs, paying particular attention to the contribution of contextual features often related to DLLs' experiences. Moreover, we consider how methodological challenges associated with researching DLLs may affect our understanding of the joint development of self-regulation and language in this population. We conclude by presenting implications for future research that seeks to further clarify the relation between self-regulation and language development among DLLs.

## The Developmental Parallels of Self-Regulation and Language

### Self-Regulation Development

We consider self-regulation an umbrella term for an array of cognitive, emotional, and behavioral processes, including planning, working memory, and persistence (Jones et al. 2016; Jones and Bouffard 2012). In this article, we focus primarily on two multidimensional regulatory skills that are often considered in relation to language: executive function (EF) and effortful control (EC) (e.g., Blair and Razza 2007; Salmon et al. 2016). EF refers to the cognitive processes that facilitate goal-directed behavior, often subdivided into inhibitory control, working memory, and cognitive flexibility (Best and Miller 2010; Diamond 2013; Nigg 2000). EC refers to the emotional and behavioral processes that facilitate the suppression of dominant thoughts, emotions, or behavioral impulses (Lengua 2009; Rothbart et al. 2003).

Despite similarities in their component skills (i.e., inhibitory and attentional processes), EF and EC are regarded as distinct dimensions of self-regulation. Whereas EFs are cognitive skills and thus frequently studied in emotionally neutral settings, EC is grounded primarily in the emotional domain of social-emotional learning and is often measured in the presence of emotional stimuli (Jones et al. 2016; Liew 2012; Zhou et al. 2012).

Self-regulation emerges during the first and second years of life and rapidly transforms between the ages of three and five (Hendry et al. 2016; Jones et al. 2003; Weintraub et al. 2013). In infancy, children acquire the ability to orient their attention toward external distractions (e.g., a toy or a caregiver's face) in times of distress to temporarily regulate emotions (Harman et al. 1997). Such attentional skills are thought to precede and predict children's later self-regulation competency (Cuevas and Bell 2014; Kochanska et al. 2000; Posner et al. 2012). In the ensuing years of early childhood, individuals begin to exhibit the components of EF and EC, including the emerging capacity to inhibit dominant cognitive, emotional, and behavioral impulses (Carlson et al. 2005; Davidson et al. 2006; Kochanska and Knaack 2004). Early regulation skills are thought foundational for more complex regulatory competencies, like planning and error monitoring, which require the concurrent engagement and integration of component skills (Best and Miller 2010; Jones et al. 2016).

Research spanning several fields has sought to identify the mechanisms of self-regulation development, identifying neurobiological and contextual features likely to promote its growth (Blair and Diamond 2008; McCoy 2013). In particular, cognitive scientists have identified neurological changes (e.g., development of the prefrontal cortex) that coincide with the emergence of observable regulatory skills (Diamond 1988; Duncan and Owen 2000). Others, including developmental psychologists and sociologists, have uncovered associations between self-regulation development and environmental conditions, like the nature of children's relationships with adult caregivers and the values of children's cultures (Carlson 2009; Cuevas et al. 2014; Eisenberg et al. 2005).

The bioecological theory of human development offers a conceptual framework for understanding the interaction between physiological and ecological factors as engines of self-regulation development (Bronfenbrenner and Morris 1998, 2006). Bioecological theory asserts that children develop through reciprocal interactions with surrounding contexts, which include their family, neighborhood, and broader culture. Sameroff (2010) extends this theory to self-regulation, highlighting the evolution of children from "other-regulated" in infancy to "self-regulated" in early childhood spurred by interactions with contexts. Through interactions, children also contribute to their surrounding

environments (Bronfenbrenner and Morris 2006). For example, a dysregulated child may exacerbate family dynamics as a result of challenging behaviors, reducing the likelihood of positive adult-child relationships in that context.

## Language Development

Like self-regulation, language is a broad construct that comprises a constellation of skills. These skills are often grouped into four categories: phonology (the sounds in speech); semantics (the meaning of words, or vocabulary knowledge); morphosyntax (how words and parts of words fit together); and pragmatics (the social norms of language use, or communicative competence) (see Gleason and Ratner 2009 for a review). Together, these competencies constitute a communicative system that is essential for literacy, school learning, and social connection. The oral language skills that develop in early childhood lay the groundwork for later reading comprehension (Dickinson and Tabors 2001; National Early Literacy Panel 2008). Moreover, language is used to self-reflect, advocate for one's needs, and build social relationships.

The process of language development begins in utero with attention to the prosodic quality of maternal speech (Nazzi et al. 1998). It continues in infancy with prelinguistic vocalizations (Stoel-Gammon 1998), gestures (Masur 1983), specialization in discriminating the speech sounds of the language(s) in the environment (Kuhl 2015), and a growing ability to engage in joint attention by the end of the first year (Tomasello et al. 2005). In the second year of life, most children reach the milestones of producing their first words and combining words into multiword utterances (Fenson et al. 1994). Gains in pronunciation, vocabulary, grammar, and communicative competence become increasingly visible between ages three and five, and oral language skills acquired in this period are strongly predictive of later academic outcomes (Dickinson et al. 2003; NICHD Early Child Care Research Network 2005).

All typically developing children are biologically equipped to capitalize on the speech of caregivers and communicative opportunities in their environments to acquire language, and variation in these environmental supports is associated with differences in the pace at which language skills develop (see Hoff 2006 for a review). Applying Bronfenbrenner and Morris' (2006) bioecological framework to language development, the environmental supports for language development include both distal factors, such as culture and social class, and proximal factors such as language interactions at home and school. At the proximal level, a growing body of research documents the importance of responsive verbal interactions that expose children to a diversity of words and grammatical forms and elicit talk that extends beyond the here and now for language

outcomes (Dickinson and Porche 2011; Rowe 2012; Weizman and Snow 2001).

## Self-Regulation and Language Development Among DLLs

Although the broad bioecological processes (i.e., children's interactions with their environments) underlying self-regulation and language development are not thought to differ for DLLs, much research has documented average differences by language background in children's skill levels in both domains. In terms of self-regulation, substantial evidence suggests that DLLs develop stronger regulatory-related skills than monolinguals (Adesope et al. 2010; White and Greenfield 2017). This has been particularly true for self-regulation skills related to executive function processes like inhibition (Barac et al. 2014; Bialystok 2017; Bialystok et al. 2010; Esposito et al. 2013; Poulin-Dubois et al. 2011). Less is known about how DLLs compare to non-DLLs in the more affective aspects of self-regulation (i.e., effortful control), but several studies found that teachers rated DLLs more positively on self-control, behavior, and teacher-student relationships (Luchtel et al. 2010; Winsler et al. 2014b). Similarly, Han (2010) found that proficient bilingual DLLs grew more than other subgroups in teacher-rated social-emotional skills and had fewer behavioral problems.

In terms of language, DLLs tend to perform lower on vocabulary measures in each of their languages than children acquiring one language (Bialystok et al. 2010; Hoff et al. 2012; Oller et al. 2007), though exceptions have been documented (De Houwer et al. 2014; Smithson et al. 2014). Relatedly, DLLs tend to have labels for a comparable number of concepts as monolinguals when considering both languages (Mancilla-Martinez et al. 2018; Pearson et al. 1993). Given the distributed nature of DLLs' skills across languages, measures of linguistic skills that consider only one language are likely to underestimate overall competencies in the domain.

## The Indirect and Direct Relations Between Self-Regulation and Language

The brief overview of self-regulation and language development presented above highlights similarities between the two domains. They are multidimensional and foundational skillsets that develop rapidly in the first five years of life (Dickinson and Tabors 2001; Gleason and Ratner 2009; Jones et al. 2016; Moffitt et al. 2011). Contemporary thinking also asserts that interactions between children and their contexts are developmental levers for both self-regulation and language skills (Hoff 2006; McCoy 2013). Finally, language background relates to children's skills in

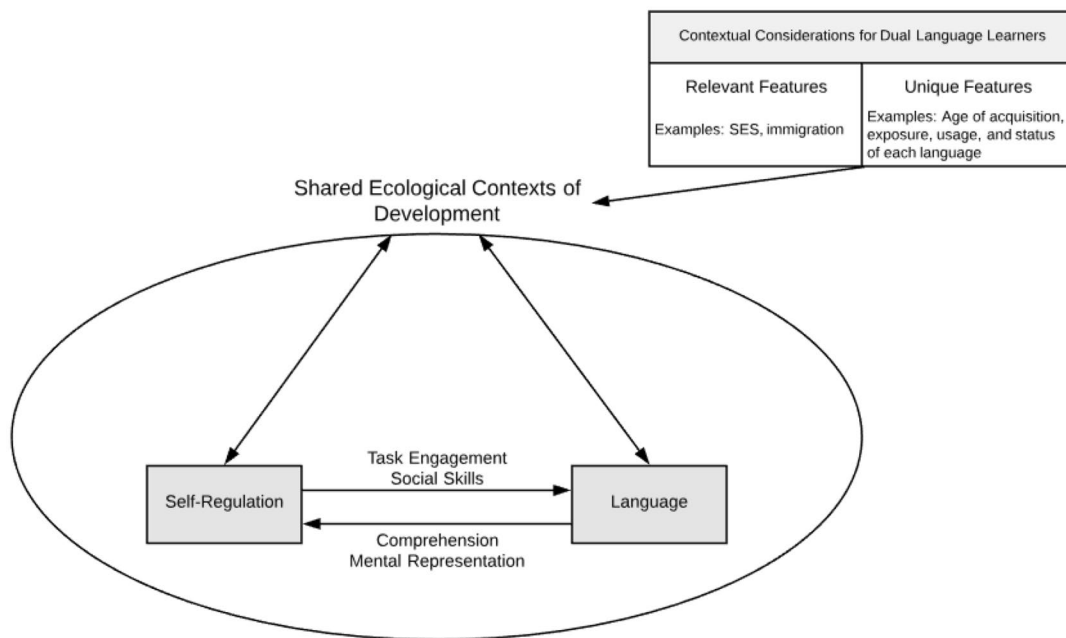
the two domains. Whereas DLLs tend to have an advantage as compared to monolinguals on certain regulatory-related skills (Bialystok 2015), they often have smaller vocabularies in each of the languages they speak than monolinguals in those languages (Bialystok et al. 2010).

Beyond these developmental parallels, much research illustrates dependencies between self-regulation and language skills. Whereas language is thought to contribute to self-regulation, self-regulation is also thought to support language. In addition to these direct relations, self-regulation and language skills are likely indirectly related through their shared environmental conditions. Empirically, the direct and indirect relations between self-regulation and language often manifest in positive cross-sectional associations between skills in the two domains and in the predictive nature of skills in one domain for skills in the other domain at a later point (e.g., Fuhs and Day 2011; Kuhn et al. 2016). Figure 1 presents our conceptual model for organizing existing research on the direct and indirect relations between self-regulation and language. We use this model in the subsequent sections to guide our review of the research base and to consider whether the model holds among DLLs. Although much work has explored DLLs' self-regulation and language development independently, less work has considered how the connection between skills in the two domains may vary by language background.

## The Indirect Relation Between Self-Regulation and Language Through Context

The shared contexts of self-regulation and language development bind skills in the two domains, as it is unlikely that any environmental feature or occurrence that affects one domain will not also affect the other. In Fig. 1, self-regulation and language are enveloped by the shared ecological contexts of development. Some empirical work has sought to isolate the relation between self-regulation and language attributable to their shared contexts. Much of this research has focused on quantifying the association between, on the one hand, the socioeconomic status of children's families and communities and, on the other hand, children's self-regulation and language competencies (e.g., Dilworth-Bart 2012; Nesbitt et al. 2013; Noble et al. 2005; Rhoades et al. 2011). Largely these studies find that children living in contexts defined by low socioeconomic status tend to have lower self-regulation and language skills than their peers in higher-income contexts.

More rigorous evidence on the role of context in shaping the domains' joint development come from quasi-experimental methods that exploit exogenous changes in children's contextual realities (e.g., an earthquake or violent incident) to isolate their causal effect on children's self-regulation and language outcomes (e.g., Gomez and Yoshikawa 2017; Sharkey 2010). One such study found that community violence had simultaneous adverse consequences for preschool



**Fig. 1** Conceptual model of the direct and indirect relations between self-regulation and language development. *Note* The direct relations between self-regulation and language are represented with the two arrows between the domains, with potential mechanisms of

direct relations written in text. The indirect relations between the two domains are indicated by the bidirectional arrows between each domain and the shared ecological contexts of development

children's vocabulary, attention, and impulse control (Sharkey et al. 2012). Importantly, many of these studies fail to identify the mechanisms through which environmental features, like violence, influence children's self-regulation and language development, highlighting an important area of future research. For example, it could be that such incidences adversely affect children's opportunities to engage in meaningful interactions that promote skills in both domains (McCoy 2013).

### Indirect Relations Among DLLs

As with all children, context plays a key role in jointly shaping DLLs' self-regulation and language, and the unique contextual realities of DLLs matter for understanding both the diversity within this group and the development of skills in these two domains. Below we briefly describe two sets of contextual features: (1) features that are relevant to other groups but tend to overlap with DLL status, such as immigration history and socioeconomic disadvantages; and (2) features that uniquely apply to DLLs due to the distributed nature of their language experience and skills. The upper right-hand box in Fig. 1 illustrates how these so-called relevant and unique features, respectively, may define the contextual inputs to DLLs' self-regulation and language development.

Dual language learners' development is shaped by risk and protective factors that can apply to all children but tend to coincide with DLL status (i.e., relevant features). In the USA, national data from Head Start suggest that the majority of DLLs are US-born children of immigrant parents and are more likely to live below the poverty threshold than non-DLLs (Aikens et al. 2017). Thus, exposure to stressors related to poverty, immigration, and acculturation often plays a role in DLLs' development. In recent years, immigration policies involving family separation and parental deportation have increased the likelihood that DLLs will experience adversity that interferes with healthy development (Lu et al. 2018; Zayas et al. 2015).

At the same time, immigration and culture may serve as protective factors for DLLs. Children of immigrants are more likely to live in two-parent households with at least one parent working full time (Hernandez and Napierala 2012). Additionally, first-generation immigrants have been found to draw strength from a greater sense of optimism regarding their opportunities for success (Ogbu and Simons 1998), which, together with cultural values of family cohesion and the importance of education, may help explain higher ratings of social-emotional skills for newer immigrants compared to those from later generations (Crosnoe 2007; De Feyter and Winsler 2009). These contextual features related to socioeconomic status, immigration status, and culture have documented associations with self-regulation and

language development among all children, but for DLLs, disentangling their effects from those related to language can be methodologically challenging (Halle et al. 2014). When studies have adequately controlled for these demographic factors, apparent developmental differences in self-regulation and language by DLL status are minimized (Winsler et al. 2014a).

In addition to factors that tend to be associated with but are not unique to language background, the context in which DLLs develop is distinctly characterized by their complex linguistic environments (i.e., unique features). Unlike monolinguals, DLLs receive inputs and acquire skills across multiple languages, which places unique demands on children's regulatory and linguistic capabilities. Specifically, the language environments of DLLs require greater attention in order to successfully distinguish between and use multiple languages appropriately, which may form the basis for DLLs' regulatory-related advantages (Bialystok 2015). These same features may also influence children's language development by determining the quantity and quality of inputs received in each language at home and in other contexts, like school (Buac et al. 2014; Collins 2014; Hoff et al. 2017; Méndez et al. 2015; Pearson et al. 1997). For example, Hoff et al. (2012) found that the relative quantity of English and Spanish heard at home positively predicted children's vocabulary in each language. Moreover, indicators of input quality in each language, such as parents' native language(s) and years of education in each language, account for variation in DLLs' language skills (Hoff et al. 2017; Place and Hoff 2011). Additional features that define DLLs' language history and environments include the age at which children began acquiring each language, their proficiency in each language, and how their minority language is viewed by their community (Surrain and Luk 2017). Together, these environmental features help account for the apparent paradox in DLLs' advantage on particular regulatory-related skills and disadvantage on some observed language skills.

### The Direct Relations Between Self-Regulation and Language

In addition to their indirect relations via shared contexts, self-regulation and language are directly related to each other, as illustrated by the horizontal arrows between self-regulation and language in Fig. 1. Language is essential for the development of self-regulation as it serves as a tool for children to mentally represent and guide self-regulation and to comprehend the regulation-related directives of others (Astington and Baird 2005; Vygotsky 1986; Zelazo et al. 2003). At the same time, self-regulation supports language development through improved social relationships, engagement, and ability to implement the flexible rules of language (Colé et al. 2014; Eisenberg et al. 2010; McClelland

and Cameron 2012; Morrison et al. 2010). Children with higher regulatory levels may have greater opportunities for language-rich interactions and are better prepared to take advantage of those opportunities. We further explain and synthesize evidence on these direct relations below.

### Language's Direct Contribution to Self-Regulation

Even before developing the ability to verbally communicate, children's capacity to understand language aids their comprehension of regulation-related guidance from others (e.g., a parent providing instructions on acceptable behavioral or emotional responses). In subsequent years, language plays a role in facilitating children's transition from reliance on other-regulation led by caregivers to self-regulation (Diaz and Berk 1992; Sameroff 2010; Vygotsky 1978; Winsler et al. 2000). Specifically, between the ages of three to five children begin to use language in novel ways (beyond its initial use for interpersonal communication) to plan and direct thoughts, behaviors, and emotions (Winsler et al. 1997). Thus, children with stronger language abilities will be more equipped to understand regulation-related cues in their environments and to internally direct their regulation.

Evidence that language promotes self-regulation development comes primarily from studies that explore the predictive power of children's language competencies for growth in self-regulation skills over time (e.g., Fuhs and Day 2011; Kuhn et al. 2014; Miller and Marcovitch 2015; Morgan et al. 2015; Petersen et al. 2015; Winsler et al. 2000). For example, Fuhs and Day (2011) found that among preschool-aged children, verbal abilities (i.e., receptive and expressive vocabulary) in the fall were predictive of children's spring EF, controlling for fall EF levels. In a study with younger children, Kuhn et al. (2014) determined that even the earliest of linguistic abilities, such as gesturing at 15 months, were relevant for EF at age four. This collection of studies, which Salmon et al. (2016) review in detail, suggests that early language skills are foundational for children's later self-regulation.

### Self-Regulation's Direct Contribution to Language

Self-regulation also contributes to language development. Specifically, the cognitive aspects of self-regulation (i.e., EF) may affect linguistic abilities by increasing children's engagement in language-building interactions and tasks (Bohlmann and Downer 2016). For example, children with high levels of inhibitory control can pay greater attention while engaged in conversation with adults, which in turn allows children to retain a greater proportion of the vocabulary, syntax, and pragmatics employed by those adults. At the same time, children with strong cognitive flexibility may be adept at successfully applying the variable rules

of language (Blair and Raver 2015; Colé et al. 2014). For instance, some words are pronounced the same but have context-dependent meanings (e.g., bear and bare) and some conventions of language are only appropriate in certain contexts (e.g., certain topics are only appropriate to discuss with familiar adults).

The emotional and behavioral aspects of self-regulation (i.e., EC) may additionally influence language development by improving children's ability to confront the emotional and behavioral demands of language acquisition. Effortful control allows children to overcome contextual distractions and emotional stimuli present in real-world settings for learning (Blair 2002; Eisenberg et al. 2005). For example, frustration is a natural response to feeling misunderstood while engaged in social communication, which is a frequent occurrence for children with emerging language skills. Children that are able to regulate emotional impulses and persist in the face of challenges have multiple opportunities to practice language as opposed to those children who stop after a failed attempt. Moreover, EC may underlie children's social skills, which in turn influences their opportunities to engage with others (Eisenberg et al. 2010).

Much empirical work suggests that various aspects of self-regulation predict children's language growth over time (e.g., Blair and Razza 2007; Fitzpatrick and Pagani 2012; Fuhs et al. 2014; McClelland et al. 2007; Segers et al. 2016; Sektnan et al. 2010). Additionally, some studies have tested several of the proposed mediators between self-regulation and language, including task engagement and social skills (e.g., Bohlmann and Downer 2016; Montroy et al. 2014; Trentacosta and Izard 2007; Valiente et al. 2011). Task engagement, for example, partially mediated the association between self-regulation and changes in expressive vocabulary among a diverse sample of preschoolers in the USA (Bohlmann and Downer 2016).

### A Bidirectional Perspective

The theoretical and empirical support for the contribution of language to self-regulation and vice versa suggests that the two domains' relation is most likely bidirectional. As such, more recent research has relied on longitudinal data to test for the existence of a bidirectional relation between skills in the two domains at multiple time points (Bohlmann et al. 2015; Cadima et al. 2018; Weiland et al. 2014). Whereas Weiland et al. (2014) only found evidence of self-regulation's predictive power for language growth across two time points during preschool, other studies have found support for a bidirectional relation. Relying on data from three time points, Bohlmann et al. (2015) used an autoregressive cross-lagged approach to show that self-regulation was predictive of vocabulary development and that vocabulary was predictive of self-regulation growth among preschoolers. Cadima

et al. (2018) similarly found that self-regulation and language skills were predictive of growth in the other domain among Portuguese preschool-aged children.

### Direct Relations Among DLLs

If self-regulation and language skills are directly and positively related as we highlight above, how is it that DLLs tend to have stronger self-regulation but relatively weak language skills as compared to children learning one language? We propose three possible explanations. First, it could be that the instruments used to measure these skills produce biased or noisy estimates for DLLs, attenuating the expected association. Second, it could be that the direct relation between self-regulation and language is specific to each language and the contexts in which that language is used. Third, it could be that when studies treat DLLs as a single homogeneous group, the average bidirectional associations between self-regulation and language in this diverse population are obscured.

First, these domains tend to be measured in ways that fail to accurately capture DLLs' self-regulation and language skills. For example, Luchtel et al. (2010) speculate that teachers may hold lower expectations for DLLs or interpret the quiet compliance of DLLs with limited English skills as indicating greater self-control, inflating teacher-reported ratings of self-regulation for DLLs. An additional example from the language domain is that language assessments administered in only one language (even if it is the child's dominant language) likely underestimate DLLs' overall language skills (Peña et al. 2016). The latter case could explain Weiland and colleagues' (2014) failure to detect a direct relation between verbal ability and self-regulation in their sample of preschoolers, of which 48% spoke a minority language at home. Though they accounted for home language as a dichotomous variable, all assessments were conducted in English, potentially underestimating the language skills of DLLs in their sample.

Second, the association between these two domains may be language specific. In other words, skills in one language could be uniquely beneficial for some aspects of self-regulation, whereas skills in the other language could be important in distinct ways. Children often face unique regulatory-related demands in the settings where they use each of their languages. For example, while the language children use at home facilitates their participation in familial life, the language children use in school facilitates their participation in academic learning (Collins et al. 2011). As such, we might expect skills in the school language to be more strongly associated with regulatory-related skills demanded in the school setting than skills in the home language. If this is the case, it may be important to consider the unique contribution of each language to children's self-regulation, yet few

studies have examined this empirically. One study of Latino kindergartners found that when Spanish and English skills were both included in models predicting teacher-rated measures of social-emotional functioning and self-regulation, the two languages were uniquely associated with different outcomes (Collins et al. 2011). Another study asked whether the quality of adult-child relationships at home and school (a potential proxy for children's regulation-related skills in each context) differentially predicted English and Spanish skills in a sample of low-income Latino preschoolers (Oades-Sese and Li 2011). They found that greater teacher-child closeness positively predicted both English and Spanish language skills, whereas parent-child attachment significantly predicted English but not Spanish skills. More research should explore the degree to which the relation between self-regulation and language may be language specific for DLLs.

Third, the direct relations between self-regulation and language may be obscured when the heterogeneity among DLLs is not considered. It may be that DLLs who are highly proficient in two languages enjoy unique self-regulation advantages, whereas DLLs with less-balanced or weaker language skills face distinct self-regulation challenges. When only the "average" DLL is considered, these divergent experiences may essentially cancel each other out. Most studies that have included DLLs as part of a larger sample treat DLL status as a dichotomous variable (Bohlmann et al. 2015; Lonigan et al. 2017; McClelland et al. 2007; Wanless et al. 2011) or control for a proxy of DLL status such as exposure to a non-English home language (Luchtel et al. 2010; Weiland et al. 2014), ethnicity (Mills et al. 2018; White et al. 2017), or the language of testing (Ponitz et al. 2009). Studies that do not consider the linguistic and social diversity among DLLs have found a negative main effect of DLL status on self-regulation and language outcomes (McClelland et al. 2007; Wanless et al. 2011) or no difference in the relation between the two domains for DLL and non-DLL groups (Bohlmann et al. 2015; Lonigan et al. 2017).

In contrast, if DLLs were segmented according to factors such as proficiency in each language and/or the degree to which each language is used at home, a clearer understanding of the relation between self-regulation and language within this population may emerge. For example, DLLs that have achieved proficiency in both of their languages likely enjoy more supportive language environments at home and school and can leverage these language skills to access more classroom instruction and build relationships with speakers of each language, enhancing their social skills (Collins et al. 2011). It may also be that it is DLLs with stronger self-regulation skills who are able to achieve greater proficiency in their languages. In fact, studies that have segmented DLLs by proficiency in each language have found that greater bilingual proficiency is associated with greater

EF and EC advantages (Han 2010; Iluz-Cohen and Armon-Lotem 2013; Palermo et al. 2017; Thomas-Sunesson et al. 2018; White and Greenfield 2017).

The other side of this coin is that DLLs who have been immersed in English-language instruction for several years but still perform below expectations in English may not be adequately supported in their language learning, and the cumulative effect of difficulties accessing content and communicating with adults and peers may exacerbate regulatory issues. Again, the directionality could go both ways, with self-regulation difficulties limiting language-learning opportunities and contributing to lower proficiency in both languages. This is also borne out in the research, as Araújo Dawson and Williams (2008) found that Hispanic DLLs who continued to struggle in English at the end of first grade (after several years of English-medium schooling) had significantly higher rates of externalizing symptoms than Hispanic students who tested as English proficient by this time point.

In light of these three explanations, the apparent paradox of DLLs' self-regulation strengths and linguistic challenges seems to arise mainly from methodological weaknesses and unwarranted assumptions. Consequently, when studying the joint development of self-regulation and language in DLLs, researchers should assess children in both of their languages with instruments that are reliable and valid for the speech communities from which their sample is drawn. They should also explore whether DLLs' skills in each language uniquely predict different aspects of self-regulation. Finally, they should attend to the heterogeneous contexts and language skills among DLLs rather than treat DLLs as one homogeneous group.

### Experimental Evidence on the Relations Between Self-Regulation and Language

The observational studies cited in the previous section provide compelling evidence that self-regulation and language skills are indeed related among both monolinguals and DLLs. Yet such correlational studies are limited in their ability to isolate the nature of the association between the domains' skills. That is, it is unclear whether the observed associations between self-regulation and language competencies are attributable to the shared contextual realities of the domains' development (i.e., an indirect relation) or to direct relations between the domains' skills. Due to elements of their design, experimental intervention studies can provide some insight into the nature of the relations between self-regulation and language skills. Experimental studies of interventions targeting features of children's contexts shed light on the indirect relations between self-regulation and language and identify environmental features that promote

the domains' joint development. Additionally, experimental studies targeting skills in one domain but not the other can provide evidence of the targeted domain's direct relation to the non-targeted domain (Jacob and Parkinson 2015). In this section, we review relevant intervention studies in light of the unique contextual and methodological considerations for DLLs highlighted in the prior section.

### Causal Evidence on the Indirect Relations Between Self-Regulation and Language

Interventions that alter the quality of children's environmental supports for self-regulation and language, often by developing the knowledge and capacity of adult caregivers, provide insight into the domains' indirect relations. Specifically, several studies of interventions targeting the quality of children's interactions with parents and educators demonstrate success at concurrently improving children's self-regulation and language skills (Bierman et al. 2018; Guttentag et al. 2014; Jones et al. 2013; Landry et al. 2006, 2008; Marti et al. 2018; Neville et al. 2013; Raver et al. 2008). For example, the My Baby & Me program worked with at-risk mothers from the end of their pregnancies until their children reached 2.5 years of age to improve maternal attention and responsiveness (Guttentag et al. 2014). As a result of the intervention, mothers engaged in interactions with children marked by warmth, contingent responsiveness, and verbal stimulation and scaffolding. In turn, children of these mothers experienced rapid growth in expressive language and engagement with their environments (e.g., a demonstrated interest in toys and other objects in the environment) during the first 30 months of life and had higher levels of social engagement at 30 months. Environmental and social engagement are precursors to children's later self-regulation skills (Salley et al. 2016).

Similarly, school-based studies show that integrated instructional approaches can positively affect children's self-regulation and language skills (Bierman et al. 2008a, b; Jones et al. 2014). Integrated approaches weave opportunities for children to practice and learn about self-regulation with instruction in other domains, like language. For instance, the Head Start REDI intervention was designed to promote the joint development of early literacy, including language, and self-regulation among preschoolers by providing teachers curricular supports and on-going training (Bierman et al. 2008a, b). Teachers implementing Head Start REDI engaged in integrated practices such as interactive read-alouds on regulation-related themes. At the end of the intervention, students of teachers in the intervention group had higher vocabulary and task engagement as compared to students of control teachers.

Both the My Baby & Me and Head Start REDI studies included children that were exposed to languages other than



English. In *My Baby & Me*, some parents received coaching in Spanish and in *Head Start REDI*, some parent interviews were conducted in Spanish (Bierman et al. 2008a; Guttentag et al. 2014). Despite the implied presence of DLLs, neither study explicitly considered how the unique contextual realities of DLLs could moderate the effectiveness of the interventions. For example, the broader sociolinguistic contexts of the *My Baby & Me* intervention likely shaped parental understandings of the status of their home language, which could have influenced adults' motivation to use that language in the interactions they were coached to have with children (Gkaintartzi et al. 2014; Hamers and Blanc 2000; Karatsareas 2018; Surrain and Luk 2017; Velázquez 2009). As such, the intervention may have been more effective for DLLs if Spanish-dominant parents were explicitly coached on the value of Spanish language interactions.

An example of a relevant contextual consideration for DLLs in the *Head Start REDI* intervention is children's exposure to the language of instruction. Children with less experience in English, for example, may have benefited more from additional English-language supports embedded in the curriculum than monolingual children (Castro et al. 2011). Relatedly, for children with low English skills, the program could have been made more effective if teachers also provided supports in the language children spoke outside of school. Some studies have found that when teachers use more Spanish in the classroom, Spanish-speaking DLLs show greater gains in both social-emotional skills and English (Burchinal et al. 2012; Chang et al. 2007). *Ex ante* in the design of interventions, researchers should consider the unique factors that might moderate interventions' effectiveness among DLLs and, *ex post* in the analysis of impacts, test whether there exist heterogeneities in effectiveness by language background and baseline proficiency in each language.

### **Causal Evidence on the Direct Relations Between Self-Regulation and Language**

As compared to studies targeting features of children's contexts, there exist relatively few experimental studies of interventions targeting skills in a single domain that also measure outcomes in the other domain. We highlight here one such intervention study conducted with preschool-aged children that primarily targeted children's self-regulation through classroom-based regulation-focused playgroups (Schmitt et al. 2015). The authors found average positive impacts of the program on children's self-regulation but not language skills, providing little evidence on the direct contribution of self-regulation to language.

The study, which had a sample comprised of 32% Spanish-speaking DLLs, as identified by teachers, explicitly sought to understand whether the intervention's effectiveness

was moderated by children's language background. As in the full sample, the authors found DLLs grew in self-regulation but not in language, but that DLLs grew relatively more than monolinguals in math as a result of the intervention. The authors reason that this finding may be the result of two factors: (1) the close connection between math and self-regulation documented in the literature (e.g., McClelland et al. 2007; McClelland and Wanless 2012) and, (2) that DLLs tend to have more risk factors than monolinguals and thus stood to benefit more from the intervention. However, by this same logic, we would have also anticipated effects on DLLs' language. An explanation for the lack of language impacts not mentioned by the authors is that DLLs were assessed only in Spanish at pre- and posttest, but the intervention was conducted primarily in English (with sequential translation in Spanish). The intervention could thus have led to improvements in English skills among DLLs that were unobserved.

This study also highlights some of the general methodological challenges and limitations of isolating the direct relations between self-regulation and language skills. Quantifying the direct causal relation between the domains requires the near impossible task of designing an intervention that influences skills in only one domain such that any effect on the non-targeted domain is due to effects on the targeted domain. Most regulation-focused interventions also involve oral or written language [as in Schmitt et al. (2015)], which could serve to directly promote children's language capacities. Conversely, language-focused interventions that require children to comply with directives or maintain focus on specific tasks provide opportunities for children to practice self-regulation. Moreover, as Jacob and Parkinson (2015) point out, interventions may need to have a minimum direct effect on the targeted domain in order to lead to noticeable impacts in the non-targeted domain. Even if intervention studies are able to overcome these challenges, they are often only able to provide insight into narrow sets of self-regulation and language skills (e.g., attention and vocabulary), rather than on the domains' direct relations across a broad range of competencies. Attempting to understand the direct relations among DLLs results in additional methodological challenges, as the study's measurement approach must seek to capture DLLs' language skills in both languages. Direct assessments of self-regulation that rely on verbal instructions are likely to also reflect children's proficiency in the language of testing.

In sum, experimental intervention studies to date have provided little evidence of the causal direct effects between self-regulation and language skills, but they do highlight the role of contextual conditions for the domains' joint development and suggest some targets for improving the quality of those environments. Specifically, empowering adult caregivers to engage in high-quality interactions with children and encouraging integrated instructional approaches appear to be

impactful approaches for promoting skills in both domains. When designing interventions that include DLLs, research should take into account the unique conditions of DLLs and consider the methodological implications of measurement and design choices for this population.

## Conclusions

In this article, we presented a conceptual model for organizing existing research on the relations between self-regulation and language and assessed the model's applicability with DLLs. Theoretical research lends support for the notion that skills in each domain directly support the development of competencies in the other domain, although causal evidence on this assertion is limited. Whereas self-regulation promotes language skills by increasing children's engagement in and opportunities for language exposure and use (Bohlmann and Downer 2016; Eisenberg et al. 2010), language allows for the comprehension of regulatory-related directives from others and facilitates the mental organization of internal regulatory processes (Vallotton and Ayoub 2011; Vygotsky 1986). More rigorous evidence offers support for the existence of indirect relations between the two domains through their shared developmental contexts. Multiple experimental studies of interventions targeting the quality of children's contexts suggest that the environmental conditions to promote self-regulation development are also those that support language skills, and vice versa (e.g., Bierman et al. 2008a, b; Guttentag et al. 2014).

We extended our organizing conceptual model to include DLLs, an important but understudied population for whom the relations between self-regulation and language might differ given the populations' unique linguistic and contextual realities. Research on proficient-bilingual DLLs tends to find self-regulation advantages, particularly in executive function, as well as some linguistic disadvantages, particularly in single-language vocabulary (Bialystok 2009). We asserted that methodological challenges and the tendency to regard DLLs as a homogeneous group may obscure the domains' relations among DLLs with different patterns of proficiency and usage in each of their languages. Studies that adequately measure and account for variation on these characteristics provide suggestive evidence for a bidirectional association, as DLLs with more balanced language proficiency exhibit better self-regulation (e.g., Thomas-Sunesson et al. 2018), and well-regulated DLLs make greater gains in language skills (e.g., Winsler et al. 2014a). To better understand the mechanisms behind these associations, future studies should account for environmental features that matter for all children but disproportionately affect DLLs (such as poverty and immigration), as well as features that are unique to DLLs (such as how their language input, usage, and skills are

distributed across their languages). Lastly, while research suggests that DLLs benefit from many of the same features of high-quality environments that promote self-regulation and language in monolinguals, the relations between self-regulation and language may be language specific. For example, support for the language that DLLs' use primarily at home may be uniquely beneficial for some aspects of self-regulation and learning in the other language (Burchinal et al. 2012; Chang et al. 2007).

Understanding the nature of the association between self-regulation and language skills can inform interventions that most effectively nurture skills in these domains among particular populations. Existing research suggests that improving the quality of children's environments—including the nature of adult-child interactions and the integration of self-regulation and language instruction—is a promising approach. These findings, along with evidence of the co-occurring patterns of risk in self-regulation and language, imply that interventions designed to target one domain may be more effective if they also incorporate a focus on the other domain. Importantly, as an increasing proportion of children across the globe are raised in environments where multiple languages are needed for communication and learning, interventions designed to foster self-regulation and language must consider the unique contexts and needs of children from diverse language backgrounds.

## Compliance with Ethical Standards

**Conflict of interest** Emily Hanno and Sarah Surrain declare that they have no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors.

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