73% of the observed bilingual (dis)advantageous effects on cognition stem from sociolinguistic factors: A systematic review

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Highlights

- Both sociolinguistic and cognitive factors modulate bilingual adaptations on cognition
- More than 73% of articles in our database attribute bilingual effects to specific sociolinguistic factors
- Bilingual advantages tend to be attributed to a cognitive origin, while bilingual disadvantages tend to be linked to a sociolinguistic origin
- Bilingualism is a dynamic experience shaped by the interaction of social, sociolinguistic, and cognitive variables

Abstract

Being bilingual confers certain behavioral adaptations. The two ongoing discussions that surround their occurrence concern the type of the effect and its origin. The former can be analyzed in terms of three outcomes: positive, negative, and null. The status of the latter is less clear. While many studies recognize some interaction of cognitive factors with social factors such as socio-economic status and sociolinguistic prestige, these observations are often made in passing and lack critical detail. Consequently, it has not been yet determined what degree of the reported bilingualism-related behavioral adaptations derive primarily from sociolinguistic factors. This systematic PRISMA-based review addresses this question. Analyzing the results of 368 studies, we find that 73.41% of the 267 studies that report bilingual adaptations attribute them either to sociolinguistic factors alone or to the interaction of sociolinguistic factors with cognitive factors. Linking the two debates, type of effect and origin of effect, this systematic review finds a previously unreported correlation: Studies that find evidence for bilingual disadvantages are more likely to claim a sociolinguistic origin, while studies that report bilingual advantages are more likely to link their findings to a cognitive origin. We discuss these results and present the key components of a sociolinguistic theory of the origin of bilingual effects.

Keywords: bilingualism, cognitive adaptations, sociolinguistic prestige, socio-economic status

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1. Introduction

Developing a theory that accounts for the effects of bilingualism on cognition is an endeavor fraught with methodological, interpretive, and expository difficulties, to the extent that it has been described as a challenge of the deepest scientific nature (Mueller Gathercole, 2015). 100 years since the first studies that described bilingualism as causing mental confusion (Saer, 1923), and 50 years since the first studies that reported bilingual advantages (Feldman & Shen, 1971; see Barac & Bialystok, 2011 for a detailed timeline), the topic of bilingual effects on cognition is still riddled with open questions (Blanco-Elorrieta & Caramazza, 2021). Although many studies have provided ample evidence for bilingual effects on cognition (often presented as bilingual advantages and disadvantages), the field still lacks a solid theory that enjoys consensus and covers critical topics such as what do the observed effects boil down to and what are the driving factors behind them (Treccani & Mulatti, 2015).

In broad terms, it can be claimed that two ongoing discussions surround bilingual adaptations on cognition. The first one concerns the type of the effects. This debate recognizes three categories of results: bilingual advantages (i.e. positive findings), bilingual disadvantages (i.e. negative findings), and null effects (i.e. findings that suggest that the differences between monolinguals and bilinguals are indistinguishable from zero). Although certain disagreements still exist in relation to the type of the effects (e.g., related to what counts as an advantage vs. a disadvantage; see Leivada et al. 2022 for an overview), several explanations have been offered for these different sets of results (Van den Noort et al., 2019; Leivada et al., 2021a; Paap et al., 2021), and all the different sides of this debate have supported their position with a solid body of evidence. Regarding the terminology we use, while we a priori reject the use of evaluative terms such as 'bilingual advantage' and 'bilingual disadvantage' as simplistic (Leivada et al. 2022), the primary purpose of any systematic review is to take stock. We thus employ these mainstream terms, following a long line of systematic reviews, meta-analyses, and quantitative analyses that adhere to the same practice (Lehtonen et al., 2018; Donnelly et al., 2019; van den Noort et al., 2019; Grundy, 2020; Ware et al, 2020).

The second debate, which concerns the origin of the observed effects, is trickier to classify in terms of main categories of results. Succinctly put, this debate deals with the following question: Where do these advantages and disadvantages stem from? One popular answer refers to cognitive factors such as enhanced monitoring abilities, increased switching flexibility, and sharpened executive control, tracing the origin of the effects to cognitive adaptations to constant language monitoring and inhibition in bilinguals (Bialystok et al., 2004a, b; 2012; Abutalebi & Green, 2007; see Blanco-Elorrieta & Caramazza, 2021 for a recent review). However, it has been argued that such cognitive enhancements may be substantially mitigated when we account for individual differences between monolinguals and bilinguals in terms of social, socio-economic, and sociolinguistic factors (Dick et al., 2019). Thus, another answer is that bilingualism and socio-economic status (SES) may both confer adaptive effects, but act independently, such that the observed bilingual advantages are not limited by social factors (Engel de Abreu et al., 2012; Calvo & Bialystok, 2014). A third answer is that both social and cognitive factors jointly contribute to enhanced self-regulatory behaviors that may lead to bilingual adaptations (Hartanto et al., 2019).

In sum, although many studies acknowledge that the observed bilingual advantages and disadvantages are amenable to a multifactorial account that recognizes the presence of both cognitive and socio-demographic/sociolinguistic factors of influence (e.g. Mueller Gathercole et al., 2010; Chen et al., 2013; Garraffa et al., 2015; Antón et al., 2019), in a large part of the literature either the interaction of the two sets of factors is not spelled out or one set of factors, cognitive or sociolinguistic, is not mentioned at all, depending on the focus of the work. Moreover, controlling for SES is undoubtedly a useful practice, but it does not fully eliminate the potential confounding effects of social factors, if many uncontrolled and ambiguous variables come into play. To give an example, overall L2 proficiency has been linked to cognitive control abilities (Luque & Morgan-Short, 2021), but proficiency across registers is tightly connected to language use in different contexts, which may be a proxy for sociolinguistic prestige (Leivada et al., 2021a). From this perspective, proficiency and use are ambiguous factors that can be plausibly read in favor of both cognitive and sociolinguistic accounts of the origin of bilingual effects.

A second example of the complex nature of this debate can be found in the many studies that test bilingualism-induced cognitive adaptations without, however, taking into account certain sociolinguistically loaded notions such as type of bilingual trajectory (i.e. simultaneous bilingual, heritage language user, L1 attriter, unbalanced second/foreign language learner). For instance, some studies control for SES, but their bilingual groups are formed based on a positive answer to one question: Does the participant speak another language other than English? (e.g. Brito & Noble, 2017). Grouping together different types of bilinguals, who acquired and, in all likelihood, use their languages in different contexts and registers, inevitably invests the bilingual group with some degree of sociolinguistic variation, the impact of which is unclear.

A different, yet related, problem comes from including into the monolingual group participants who know more than language (see also de Bruin et al., 2021 for a recent discussion of this issue). For example, Gollan et al. (2005a) found that bilinguals tested in a picture naming task differ from monolinguals at a post-conceptual processing level. Their monolingual group, however, had some exposure to an L2: "No special attempts were made to recruit monolinguals who had never been exposed to an L2 at all (such individuals would be unusual, given foreign language study requirements)" (p. 1223). The same demographic profile (i.e. L1 dominant college students with a limited exposure to an L2 in a classroom setting) is presented in Runnqvist & Costa (2012). In this study, though, these participants are classified as low proficient bilinguals, not as monolinguals.

Measuring variables such as degree of language use and proficiency is useful, however it may bring along certain challenges that contribute to the debate. Degree of use is typically measured by asking participants whether and to what degree they use two languages, or a language other the one used in the community, when conversing with friends and family (e.g. Dick et al., 2019). One challenge that comes from grouping together in one big bilingual group, people who use another language with friends and family is that heritage language learners, who fit this inclusion criterion, receive variable qualitative and quantitative input, facing socio-political and sociolinguistic pressures from the majority language spoken in their community (Montrul, 2015; D'Alessandro et al., 2021). Consequently, while the degree of use may be controlled for in many studies, the variability that is inherent to the sociolinguistic values attached to the many different languages (often more than 30), that are included in big and heterogeneous bilingual groups, is usually neither measured nor acknowledged. This is relevant to the origin of the bilingual effects debate because using two languages does not entail viewing them in a similar way or, more importantly, being able to reliably reflect on their use. Every bilingual person has a preferred language (Dodson, 1985), and both the emotional stance bilinguals adopt towards their

languages as well as the way these languages are compartmentalized and used across contexts have strong implications (Duñabeitia, 2017). In the case of non-standard or minority languages too, the sociolinguistic attitudes and the consequent alignment of a bilingual speaker/signer with the acrolectal or the basilectal pole of the standard-dialect continuum is a matter of personal preference (Grohmann et al., 2020). In practice this means that when non-official or non-standard languages are involved, (heritage) dialect users may report that they use the standard language that is most proximal to their home variety (e.g. Greek instead of Cypriot Greek, Italian instead of Neapolitan). If some dialect speakers deny that they speak a dialect altogether —reducing it to nothing more than "an accent" (Arvaniti, 2010) —, this denial poses an important challenge for the linguist, who seeks to measure degree of use of something that, in the user's opinion, does not exist as a system of its own (Leivada et al., 2019).

In sum, it has been argued that many early studies in bilingualism research were flawed because they did not control for SES or other sociocultural differences between the tested groups of monolinguals and bilinguals (Mueller Gathercole et al., 2010 and references therein). Without denying the considerable progress made since then, it seems that some recent studies are also framed in a way that allows for unaccounted variation to lend ambiguity to their results. Finding bilingual advantages and disadvantages is not enough, if we cannot explain what the effects boil down to and what factors drive them. Possibly, this is the key reason that this domain of research has been linked to "insufficiently clear theories and hypotheses that are difficult to falsify" (de Bruin et al., 2021: 433), even after decades of extensive testing. The aim of this work is to address this issue through shedding light on the origin of bilingual effects on cognition. More specifically, we seek to determine what percentage of the studies conducted in this field test and control for sociodemographic factors (Research Question 1), what percentage of studies that find bilingual advantages and disadvantages attribute them to a cognitive, sociolinguistic, or mixed origin (Research Question 2), and what sociodemographic and sociolinguistic factors are typically involved in studies that find bilingual adaptations (Research Question 3).

In relations to these Research Questions, one important challenge refers to the scope of these domains, which remains vague in the literature: What counts as a cognitive vs. a social/sociolinguistic determinant of bilingual adaptations? While some proposals are straightforward (e.g., attributing differences between monolinguals and bilinguals to cognitive processes related to general conflict-monitoring and goal-orienting abilities; Costa et al., 2009; Hernández et al., 2013), other factors are variably treated as pertaining to the sociolinguistic or the cognitive component. For example, differences in cultural knowledge may be attributed to the cognitive component (Green et al., 2007) or not (Barac & Bialystok, 2012). For the purpose of this systematic review, we employ one specific criterion (following De Cat, 2020) in classifying the origin of bilingual effects as cognitive or sociolinguistic: If the results of a study suggest that any observed differences between monolinguals and bilinguals are due to *individual-internal* cognitive processes (e.g., sharpened monitoring or switching abilities, different use of neural markers, enhanced control of attentional resources, weakened retrieval capacity), this is classified as cognitive origin. If the differences are amenable to an explanation that relies on *cognition-external* factors (e.g., SES, age, education, social prestige, sociocultural knowledge, language use in different contexts, typological proximity, script), this is classified as sociolinguistic origin.

All in all, while these sociolinguistic factors are an inherent part of the bilingual experience, we cannot afford to subsume under the generic label 'bilingualism-related factors'. In the current context of replacing dichotomous labels such 'cognitive (dis)advantage' with a more nuanced approach (Leivada et al., 2022), examining the role and magnitude of sociolinguistic factors of influence will shed light to the characteristics of

different trajectories, helping us to avoid unjust misattribution of certain labels and behavioral outcomes to people's bilingual experiences (Luk, 2022).

2. Method

We performed a systematic review of the literature on bilingual advantages and disadvantages. The review was conducted according to the PRISMA Statement (Liberati et al., 2009). Data were plotted and analyzed using R, version 4.2 (R Core Team, 2021), and jamovi, version 1.8 (the jamovi project, 2022).

A systematic search of the literature was conducted in the following databases: PsycInfo, PsycExtra, PsycBooks, APA Journals, and PubMed. The searches were conducted in December 2021. The search strategy consisted of the following keywords: "bilingual" & "advantage" OR "bilingual" & "disadvantage". As these are popular terms, a total of 1753 articles were obtained from this search procedure, which marks the highest number of screened studies in a systematic review/meta-analysis in bilingualism research. Duplicates were removed through Mendeley Desktop software, and the remaining abstracts were screened for content. First, two investigators (C.M. & V.D.) independently searched the databases, selected the relevant studies, and extracted the data, following predefined criteria. In cases of disagreement, a third researcher (E.L.) was asked to evaluate the study in question for inclusion. In all cases, consensus was eventually reached among all authors.

The selection of relevant studies was conducted based on previously determined inclusion and exclusion criteria. First, studies had to present original experimental results. Therefore, meta-analyses, review articles, and theoretical articles were excluded. Second, studies had to be written in English. Third, studies had to be published after 1960. Fourth, studies involving neuroatypical populations were excluded. Fifth, data from at least one monolingual and one bilingual group had to be reported, to avoid any bias of grouping together fundamentally different groups. Last, studies focusing solely on the brain without any reference to behavioral measures were excluded. The obtained database covers results from 368 studies, 474 experiments, and 109.604 participants. Fig 1 presents the screening and selection process.

Fig 1. PRISMA Flow Chart.

The pool of data and the complete list of studies that were analyzed for this review are available at: https://osf.io/2z4cx/?view_only=95009316afe3479aa3249b419551a6b4. In the classification of the screened articles, the sociodemographic variables of age, gender, and SES, together with the language profile, are presented, when measured. With reference to SES, studies are divided in three groups: studies that did not mention it, studies that merely acknowledged it in their introduction or discussion sections, and studies that either measured it or controlled for it by group matching. Articles were subsequently screened to determine both their reported bilingual effects (i.e. bilingual advantage, bilingual disadvantage, both effects, or null effect) and the origin of the effects (i.e. cognitive origin, sociolinguistic origin, or mixed origin).

3. Results

The findings of the analyzed studies are first classified according to the bilingual effects they report. Considering the entire pool of data, comprising a total of 368 analyzed articles, 57.34% of them report a bilingual advantage, 11.41% report a bilingual disadvantage, 3.80%

find both advantageous and disadvantageous effects and 27.45% find a null effect. These advantages and disadvantages pertain to any cognitive domain (e.g., executive functions, memory, metalinguistic awareness, different types of fluency, syntactic processing, phonological awareness, etc); unlike most previous systematic reviews and meta-analyses on bilingual adaptations, we did not limit our pool of results to one cognitive domain (typically, executive functions). Figs 2 and 3 present a summary of the distribution of effects.

Fig 2. Distribution of Effects.
Fig 3. Distribution of Effects per Category.

The findings of the analyzed studies are subsequently classified into the following three categories:

(i) Effects attributed to social, sociolinguistic, or sociodemographic factors (category "sociolinguistic origin")
(ii) Effects attributed to a combination of sociolinguistic and cognitive factors (category "mixed origin")
(iii) Effects attributed exclusively to bilingualism and cognitive adaptations linked to it (category "cognitive origin")

Fig 4 presents a summary of the origin of effects.

Fig 4. Origin of Effects.

Encompassing a variety of tasks and populations, our results suggest that 73.41% of the screened studies that find bilingual effects can be linked to either a sociolinguistic (category (i)) or mixed origin (category (ii)). The overall distribution of these effects in terms of origin is shown in Fig 5.

Fig 5. Distribution of Bilingual Effects for Type and Origin.

Treating effect and origin as multinomial variables, a generalized linear model suggests that type of origin is significant in the overall sample (χ^2=16.4, p=.003). Table 1 presents the model results and Table 2 presents the post-hoc comparisons with Bonferroni correction for multiple comparisons. The significant difference boils down to the fact that studies that find bilingual disadvantages are more likely to attribute them to sociolinguistic factors, while those that find bilingual advantages are more likely to claim that bilingualism confers cognitive enhancements.

Table 1. Model results.

						95% Exp(B) Confidence Interval			
Response Contrasts	**Names**	**Effect**	**Estimate**	**SE**	**exp(B)**	**Lower**	**Upper**	**z**	**p**
Both - Advantage	(Intercept)	(Intercept)	-2.726	0.281	0.06555	0.0941	0.224	-9.707	<.001
	Origin 1	Cognitive - Sociolinguistic	0.251	0.727	1.2857	0.0593	0.531	0.346	0.729
	Origin 2	Mixed - Sociolinguistic	0.595	0.666	1.8134	0.1661	0.848	0.893	0.372
Disadvantage - Advantage	(Intercept)	(Intercept)	-1.93	0.221	0.1451	0.0378	0.114	-8.7	<.001

								43	
	Origin 1	Cognitive - Sociolinguistic	-1.73	0.559	0.1773	0.3094	5.343	-3.093	**0.002**
	Origin 2	Mixed - Sociolinguistic	-0.98	0.416	0.3752	0.4913	6.693	-2.358	**0.018**

Table 2. Post-hoc comparisons.

Effect	Origin	Difference	SE	z	$p_{bonferroni}$
Advantage	Cognitive-Mixed	0.0703	0.0568	1.236	0.788
	Sociolinguistic-Cognitive	-0.1768	0.0567	-3.119	0.062
	Sociolinguistic-Mixed	-0.1065	0.0602	-1.769	0.382
Disadvantage	Cognitive-Mixed	-0.0534	0.044	-1.213	0.812
	Sociolinguistic-Cognitive	0.198	0.0491	4.032	**0.021**
	Sociolinguistic-Mixed	0.1446	0.0534	2.707	0.106
Both	Cognitive-Mixed	-0.0168	0.0397	-0.424	1
	Sociolinguistic-Cognitive	-0.0213	0.0323	-0.657	1
	Sociolinguistic-Mixed	-0.0381	0.0335	-1.136	0.898

Analyzing the role of specific sociodemographic factors in our pool of data, we find that age is controlled for in 98.91% of studies (n=364/368), followed by gender which is assessed in 70.92% of studies (n=261). With reference to SES, this variable is unmentioned in 35.60% of studies (n=131), whereas 11.41% of studies (n=42) mention it in their introduction/discussion sections, without measuring or controlling for it. In the remaining 52.99% of studies (n=195), SES is controlled for in the matching of the tested samples.

With reference to the sociolinguistic factors that come into play in the emergence of bilingual effects, the most frequently encountered variables are those related to the sociolinguistic status of the languages (e.g., societal status, context of acquisition and learning trajectory) and to the actual practice of using of them in different contexts (e.g. language exposure/use, amount of switching). Overall, the sociolinguistic factors that come into play can be classified in terms of the following four tightly connected categories, which only together can outline the complexity of the bilingual nature.

1. Variables related to how bilinguals experience and use their languages. These variables amount to factors involved in the emergence of bilingual effects, and include age of acquisition, length of bilingual experience, proficiency measures, literacy competence, measures and domains of language use, both in relation to the amount of use specific to a given language —thus including measures of language switching—, and to specific contexts of use, and measures of language exposure, including language immersion.
2. Variables related to the sociolinguistic context where bilinguals use their languages. These concern the sociocultural and sociolinguistic properties of the environment: the societal status of a language, the culture and patterns of use associated with it, the learning context of a given language, the subsequent communicative and learning demands posed on speakers/signers.

3. Variables related to the sociodemographic profile of participants, that in turn can both affect their bilingual experience and act independently. These include age, gender, and aspects of SES, including education, parental education, and profession.
4. Variables related to linguistic factors. This category refers to the variability and diversification of the linguistic input as well as the typological properties, including script, of the languages at play.

While the classification of variables in the aforementioned categories serves organizational purposes, it does not entail the absence of gray areas between them. This means that these categories are not rigidly demarcated but host variables that occur on a continuum of influencing factors, as shown in Fig 6. In relation to magnitude of contribution, Fig 7 shows the occurrence of each sociolinguistic factor individually in (i) the studies that find results that evoke a sociolinguistic/mixed origin and (ii) the overall pool of data (i.e. all studies that find evidence for bilingual adaptations, regardless of origin). Table 3 presents the overall occurrence of each factor in (i) the studies that find results that evoke a sociolinguistic/mixed origin, (ii) the overall pool of data, and (iii) the context of the entire range of sociolinguistics factors. With respect to (iii), a study may find evidence for more than one sociolinguistic factor, so the total instances of mentioned sociolinguistic factors and the total number of studies do not coincide.

Fig 6. Sociolinguistic factors that have been linked to bilingual adaptations. Color warmth indicates degree of occurrence in the pool of data.

Fig 7. The occurrence of individual sociolinguistic factors in the pool of data. Other factors include language dominance, language similarity/typology, length of bilingual experience, biliteracy, vocabulary size, bilingual trajectory, profession, education, gender, minority language status, script, subtractive bilingualism, acculturation, input variation/diversity, age of literacy acquisition, personal motivation, multicultural identity, and parental education. The complete list is provided in Table 3. The x-axis values show degree of occurrence in the overall pool of data on 0-1 scale.

Table 3. Magnitude of contribution for each sociolinguistic factor.

Sociolinguistic factor	Occurrence in studies with a sociolinguistic/ mixed origin	Occurrence in the entire pool of data	Occurrence in the total range of sociolinguistic factors
Proficiency	22.96%	16.85%	15.31%
Bilingual/multilingual exposure	17.86%	13.11%	11.90%
Language use	16.84%	12.36%	11.22%
Age	12.76%	9.36%	8.50%
Bilingual (active/native) experience	11.22%	8.24%	7.48%
Age of acquisition	5.61%	4.12%	3.74%
Sociocultural context/status	5.10%	3.75%	3.40%
Immersion schooling	5.61%	4.12%	3.74%
Language switching	5.61%	4.12%	3.74%
Sociolinguistic context/status	5.10%	3.75%	3.40%
Communicative	4.08%	3.00%	2.72%

demands			
Learning/linguistic context	4.08%	3.00%	2.72%
SES	4.08%	3.00%	2.72%
Language dominance	3.57%	2.62%	2.38%
Language similarity/typology	3.57%	2.62%	2.38%
Length of bilingual experience	3.57%	2.62%	2.38%
Biliteracy	3.06%	2.25%	2.04%
Vocabulary size	3.06%	2.25%	2.04%
Bilingual trajectory	2.55%	1.87%	1.70%
Profession	1.02%	0.75%	0.68%
Education	1.02%	0.75%	0.68%
Gender	1.02%	0.75%	0.68%
Minority language status	1.02%	0.75%	0.68%
Script	1.02%	0.75%	0.68%
Subtractive bilingualism	1.02%	0.75%	0.68%
Acculturation	1.02%	0.75%	0.68%
Input variation/diversity	0.51%	0.37%	0.34%
Age of literacy acquisition	0.51%	0.37%	0.34%
Personal motivation	0.51%	0.37%	0.34%
Multicultural identity	0.51%	0.37%	0.34%
Parental education	0.51%	0.37%	0.34%

4. Discussion

Taking stock of what our review shows in relation to the two big debates that surround bilingualism, type of effect and type of origin, our results suggest that bilingual populations can indeed be associated with robust adaptations to bilingualism, confirming the results of van den Noort et al. (2019) and Grundy (2020). Analyzing the occurrence of bilingual effects in our sample (Fig 2), a χ^2 Goodness of Fit suggests a significant difference in study outcome, with 72.55% of the studies in our pool of data finding evidence for bilingual effects (χ^2=74.9, p< .001). Recall that 73.41% of these studies attribute to them to sociolinguistic factors.

Importantly, the reported bilingual effects include both advantages and disadvantages. An important matter that arises concerns the publication biases that have been argued to favor the publication of results that support positive outcomes (de Bruin et al. 2015). As Fig 8 shows, while bilingual advantages are the most frequent category (8a), if we follow the previous practice of grouping null and negative outcomes in one category (following the classification system in de Bruin et al. 2015), the negative/null category (8b) is not the least frequent one, as we expected based on the literature. At the same time, the classification system matters. If bilingual advantages and disadvantages form trade-offs (Leivada et al. 2021b), it is more reasonable to group negative outcomes with positive outcomes (8c) than with null effects (8b). A null result (i.e. failure to find an effect) is not the same with finding

evidence for a negative outcome, hence grouping them together may not do justice to the observed correlations between positive and negative outcomes.

Fig 8. Different Ways of Grouping Bilingual Effects.

Overall, this review addresses three questions: What percentage of the studies that report bilingual effects control for sociodemographic factors (Research Question 1), what percentage of the studies reporting such effects attribute them to a cognitive, sociolinguistic, or mixed origin (Research Question 2), and what are the sociolinguistic factors most typically involved in studies that find bilingual adaptations (Research Question 3).

Regarding the first research question, it was found that all 368 articles in our pool of data controlled for at least one sociodemographic factor: age, gender, and/or SES. While only four studies did not account for age in their sample, almost 30% of the articles did not report their participants' gender, despite the potential impact of this variable (Kormi-Nouri et al., 2003; Tarighat & Krott, 2021). With reference to SES, more than 60% of studies at least mentioned it, and more than 50% either measured it or used it as a matching variable in sample selection. In relation to the second research question, our results suggest that the observed effects are predominantly attributed to sociolinguistic factors. The relevance of sociolinguistic factors becomes even stronger if we consider the studies that ascribe their findings to both sociolinguistic and cognitive origins (Fig 4). These findings attest to the need for developing a social-based theory for explaining the origin of bilingual effects, further suggesting that bilingual adaptations are a mosaic trait that entails a large number of variables belonging to different sociolinguistic domains. The bilingual status, in fact, is not enough, raising the question of "how bilingual one needs to be to benefit from a cognitive advantage" (de Cat et al. 2018, p. 125), or more broadly, for advantageous and disadvantageous effects to be observed? Not only the outcome (which is variably described in terms of advantages, disadvantages, mixed effects, and null effects; Fig 3), but also the origin boils down to a mosaic of intertwined variables (Fig 6): There are many both sociolinguistic and cognitive factors that work together or compete in conferring cognitive adaptations (Valian, 2015). For example, profession is one of them: interpreters are more likely to perform well in certain cognitive tasks that test specific abilities which are trained while at work (Yudes et al., 2011; Henrard & Van Daele, 2017). The results of the present review seem to suggest that the more bilingualism is broken down into those particular components that define different types of bilingualism (e.g. use, status, proficiency, etc), the more likely it is that the ecologically broad *bilingual effect* may be ascribed to something more specific, which oftentimes happens to be of sociolinguistic, rather than cognitive, nature. It seems that the question concerning the origin of bilingual effects is hard to address, most notably because of the variability of the samples. While the terms "bilingualism" and "bilingual" are employed in such a way that their ecological validity seems to be faced with little to no exceptions, the tested samples in the analyzed studies have surprisingly little in common. Participant selection and group matching criteria are by no means fixed, which means that some variables that have been shown to influence results, such as SES, are sometimes considered, and sometimes not. The main concern when talking about measures that are necessary in order to identify a testable sample, also coincides with the partial lack of predictions related to such measures. Why, for instance, include participants' data on health status (Wang, 2015), if this provides no theoretically solid predictions on specific task performance? How should one interpret factors like proficiency, which in principle may be plausibly related both to the cognitive and the social dimension? Moving beyond these questions, our hypothesis is that the rate at which bilingual advantages and disadvantages are attributed to sociolinguistic factors can be traced back to how bilingualism itself is conceptualized in study design and sample selection. The

more multifaceted the bilingual experience is considered, the more likely it is that the origin of its effects will be traced back to a specific subcomponent of bilingualism, recognizing some of the many sociolinguistically-informed nuances of the bilingual experience.

Factorizing these subcomponents may then be the key to finding the origin of bilingual effects. More concretely, we propose that tracing the effect of bilingualism back to cognitive or sociolinguistic factors partially depends on how gradually bilingual experience itself is represented (i.e. as a spectrum vs. a binary option that is based on the question 'Does the participant know any language other than language X?', cf. DeLuca et al., 2019; Sulpizio et al., 2020). Defining bilingualism through isolated factors/parameters (i.e. L1/L2 proficiency or age of acquisition as stand-alone elements) may lead to an oversimplified view of this notion: being bilingual is not a dichotomous condition depending on just one factor, rather it is a gradient status where different sociolinguistic/cognitive factors play crucial roles, together with inter-individual variability. Delineating the whole range of the implicated variables as well as their strength of contribution (as in Figs 6 and 7) can be a successful way to approach the bilingual nature. A better conceptualization of bilingualism is also the key to interpret its effects (Diaz & Farrar, 2018). Indeed, controlling different subcomponents of bilingualism enables a better linking of bilingual effects to specific factors of the bilingual experience, offering a possible solution for the so-called inconsistency of effects (Marton et al., 2017). The upshot is that bilingualism should be perceived as the result of a thick network of sociolinguistic factors that influence each other in a chain-reaction fashion.

The resulting question, then, is about the specific sociolinguistic factors that give rise to bilingual effects; this was the third research question of the present research. Our results show that the sociolinguistic origins of bilingual effects can be ascribed to a continuum of social, sociodemographic, sociolinguistic, linguistic, and language experience/use factors (Fig 6). These variables appear to be intrinsically linked in a thick network, influencing each other, and defining the bilingual experience as the sum of each of these variables. The close junction of sociodemographic and sociolinguistic factors is clearly shown by SES, a social variable frequently addressed in our pool of data, as previously discussed. With respect to SES assessment, the reviewed studies show a great variability of measures: some authors assert their sample homogeneity through explaining that only participants of the same neighbourhood or geographical area were recruited (e.g. Duñabeitia et al., 2014), others calculate SES by summing up different proxy variables such as educational level, type of occupation, and position in the occupation (e.g. Chrysochoou et al., 2020), while in other cases, especially in studies focussing on children, parental education is measured as an approximate value for SES (e.g. Goetz, 2003; Lesniak et al., 2014; Giguere et al., 2022). Moreover, SES has often been linked to bilingualism, both in a synergistic way that builds on the import of other variables and in an independent way. The independent effects of SES have been shown by Morton & Harper (2007), who found that children from high-SES families have smaller inhibition costs compared to their low-SES peers, and this result was found regardless of being monolingual or bilingual. A negative effect of low-SES on children was also reported by Meir & Armon-Lotem (2017) and Korecky-Kröll et al. (2018); in the latter, the SES effect was stronger for monolingual children. Besides the independent effects of bilingualism and SES, some research has also reported the synergistic effect of the two. Brito & Noble (2017) show how SES and bilingual experience are linked to brain structure and cognitive skills, both independently and interactively; these effects were observed mostly in adolescence, suggesting that the length of exposure to a bilingual environment also has an impact, and showing once again how different sociolinguistic factors interact with each other. The modulating role of SES on bilingual advantages was also shown by Naeem et al. (2018), who report an advantage in response times for bilinguals. The bilingual advantage was particularly pronounced for low-SES participants, highlighting once again the

interrelationship between SES and bilingualism (see also Engel de Abreu et al. 2012 and Hartanto et al. 2019). Similarly, Stasenko et al. (2017) provide evidence for the positive effect of language switching in their bilingual group, who had a clear SES disadvantage compared to their monolingual peers. Overall, the way in which SES and bilingual experience interact shows that variables pertaining to both the core sociodemographic dimension and variables related to the actual experience of using two languages cannot be perceived as stand-alone factors; they are crucial components of the same thick weft of variables that together give rise to bilingual adaptations. Acknowledging the reality of individual differences entails that employing umbrella terms like 'bilingual status', without pinpointing the sociolinguistic characteristics of the bilingual experience *specific* to the tested sample, may result to a substantially incomplete picture. Similarly, the mainstream practice of grouping in one bilingual mega-category a mix of people that speak or sign different L1s, acquired through variable developmental trajectories (e.g. heritage language users, immigrants that go through L1 attrition, sequential bilinguals, etc) raises similar concerns. In such cases, it is almost impossible to determine with a reasonable degree of confidence whether the claimed bilingual advantages and disadvantages are due to handling two or more languages or to some uncontrolled degree of sociolinguistic variation.

As Fig 6 suggests, variables pertaining to language use play an important role in the origin of bilingual effects. Proficiency is a clear example. Most of the reviewed studies find a positive correlation between higher degrees of proficiency and bilingual advantages (e.g. Bialystok & Majumder, 1998; Antoniou et al., 2016; Escobar et al., 2018; Segal & Gollan, 2018; Skoe & Karayanidi, 2019). Higher or lower proficiency may depend on different variables, such as language use, sociolinguistic status, context, and the consequent linguistic attitudes that speakers/signers have toward their language(s). While some studies tend to consider proficiency as a compact variable, and accordingly control for it in their samples, other studies spell out the connection of proficiency with other sociolinguistic factors. Woumans et al. (2015), for instance, explain their positive results by tracing enhanced cognitive control back to balanced language use and degree of language switching, that in turn results to higher proficiency. Tao et al. (2015) find a positive association between higher proficiency and reduced switching costs in their Spanish-English bilingual speakers, compared to Mandarin-English bilinguals and monolinguals: besides recognizing the impact of proficiency, they also consider the possible link between proficiency and different patterns of language use, together with the role of different cultures of origin. The prominence of proficiency as a primary measure to assess bilingualism can also be ascribed to the fact that this has often been used as an umbrella-notion that includes other aspects of the bilingual experience, such as language use, and in some cases, this has led some scholars to ascribe bilingual effects to proficiency only. According to Verhagen et al. (2019), the impossibility of teasing apart the effects of language proficiency and other sociolinguistic variables stems from the absence of separate measures for each independent factor.

Among these factors, there are two that merit special mention: language exposure and language use (Bedore et al., 2012). The impact of exposure is most evident in research focused on bilingual children. Going back to our pool of data, the bilingual disadvantage found by Andreou et al. (2021) is a clear example: the lower performance of Albanian-Greek bilingual children is linked to the fact that their Albanian-speaking parents chose to use the societal language (Greek) at home despite their low proficiency in this language. Interestingly, this study shows once again the close connection between different aspects of the bilingual experience: besides the crucial role of immigrant status and parental language attitudes, the quality of language exposure influences bilingual children's linguistic abilities. This point has also been discussed by Rothman (2009), who argues that quantitative and

qualitative variation in the linguistic input that bilingual speakers receive can affect their resulting grammar.

About language use, terminology matters. The term 'language use' is usually ascribed to two main concepts of using a language. The first one concerns the amount of time spent speaking/signing a language, while the second one is strictly connected to the socio-communicative environment in which the language is used. In this second meaning, the inter-dependent network of sociolinguistic factors becomes once again clear. Referring to the factor 'language use' entails considering the social context of use, that in turn can affect the percentage of time the language is spoken. Our results suggest that among the sociolinguistic factors linked to the emergence of bilingual adaptations, sociolinguistic context and communicative environment have a strong impact. The important role of sociolinguistic context in shaping bilinguals' language use is discussed in Lambert (1973) through the concept of *subtractive environment*: choosing to use one language instead of another is not a mere linguistic question, rather it entails social consequences for the speaker/signer. Several studies in our pool of data attest to the impact of language use in terms of communicative environment. Heidlmayr et al. (2014) test two groups of French-German bilinguals who differ in terms of linguistic environment. The results showed that linguistic context played an important role, since bilingual advantages were found only for those bilinguals who were deeper and longer immersed in their L2 environment, with a consequent increase of L2 language use. Wermelinger et al. (2017, 2020) attribute the positive outcomes they find for bilingual children to their increased sensitivity to communicative violations, which derives from their extensive experience in repairing communication practice. The importance of communicative context is also stressed by Karimi & Hosseini Rad (2021), who attribute the bilingual advantage in interference control to the specific interactional language use of two languages. The positive correlation between language use and bilingual effects is also shown by Shook et al. (2015), who attribute the bilingual disadvantage in auditory comprehension to weaker lexical access linked to reduced language use.

Another interesting sociolinguistic factor linked to the bilingual communicative dimension is language switching. In most cases it is drawn from other social components, and it is not independently operationalized, as are proficiency and language use (Verhagen et al., 2019). Similar to proficiency, in most cases, the frequency of language switching is found to be positively correlated with bilingual advantages (Woumans et al., 2019; Barbu et al., 2020), in line with the code-switching hypothesis of Peal & Lambert (1962). According to this hypothesis, the bilingual experience of switching from one language to another helps in reinforcing symbolic reorganization, turning into both strengthened performance in tasks requiring conceptual reorganization and better communication skills. The low frequency of language switching is also brought into play to justify the absence of positive effects of bilingualism. For example, Scaltritti et al. (2017) explain the lack of bilingual advantages for their bidialectal Italian speakers through suggesting that the latter have fewer opportunities of language switching than other bilingual populations (e.g., Spanish-Catalan bilinguals). In this case, the importance of sociolinguistic context is evident, and it shows once again how different bilingual subcomponents are linked in a chain-reaction fashion: the social prestige of a linguistic variety affects the communicative contexts in which it is used and, in turn, the frequency of switching. In Italy, dialects are perceived as less prestigious than standard Italian, therefore language switching from Italian to dialect is less frequent and occurs under few communicative dimensions. The more prestigious social status of Catalan, on the other hand, enables the use of the Catalan language in more contexts, with a consequent higher opportunity of language switching, which inevitably arises due to the need to address different monolingual Spanish-speaking interlocutors. Another interesting case of how social factors influence each other comes from Verhagen et al. (2019), who provided an explanation

for their bilingual children's advantages by linking language switching to parents' proficiency: they found that "[…] bilingual children with one or two parent(s) with a low proficiency level in one of the home languages showed enhanced performance on a selective attention task (i.e., visual search) as compared to bilingual children whose parents were proficient in both languages" (p. 19). The bilingual advantage in selective attention, thus, was explained by the frequency of switching experienced by the children, that in turn depended on the parents' proficiency: the more a child was required to switch between languages to communicate with the parents, the more pronounced was the enhancement in cognitive control.

This picture suggests that sociolinguistic factors leave a cognitive imprint, such that the different origins of bilingual effects are intertwined (Blom et al., 2017; Marian & Hayakawa, 2021). This is relevant to the debate about the origins of bilingual effects because the status of some factors may seem ambiguous. For instance, we have classified switching as a sociolinguistic factor. However, it could be plausibly viewed as a cognitive factor: having to monitor external cues in order to be able to switch engages cognitive control regions in the brain (Blanco-Elorrieta & Pylkkänen, 2017). We argue that both findings are correct: language switching indeed has cognitive implications, but its occurrence is driven by sociolinguistic happenstance. Recognizing the cognitive repercussions of switching does not mean that this is a cognitive factor per se, or that all sociolinguistic factors that recruit and affect cognitive resources should be classified as cognitive in origin. Even SES (i.e. the classic textbook example of a social factor) has an impact on neurocognitive resources (Migeot et al., 2022), but this does not prevent us from recognizing its status as a social factor. In sum, given that all social experiences may leave an imprint on cognition, it is uninformative to think of all the sociolinguistic factors as cognitive factors or lump them together under the label 'cognitive'. Instead, the emphasis should be on appreciating the individual characteristics of different *sociolinguistic ecologies* of speakers/signers (Rodríguez-Ordóñez et al., 2022). As Luk (2022: 5-6) puts it, "when shifting the research focus to people and the way that they become multilingual, it is clear that any investigation of bilingual (dis)advantage needs to consider the social contexts where language experiences occur".

Being bilingual is not just a matter of speaking or signing an additional language; it also includes the immersion in the culture of the linguistic community. While Bialystok & Viswanathan (2009) did not find specific results linked to different cultures of origin, but rather a general bilingual advantage, the impact of biculturalism was present in later studies. Rubio-Fernández & Glucksberg (2012), for example, find a bilingual advantage in false-belief reasoning, which they attribute to a greater sociolinguistic awareness that derives from the culture their bilingual participants grew in. Also, Tran et al. (2015) find a cultural effect of bilingualism. They assess the cultural background of three bilingual groups belonging to three different cultural settings (i.e. U.S., Argentina, and Vietnam) on a cultural continuum, where cultures were classified according to "[…] the tightness and looseness of societal structure for collectivism and individualism […]" (p. 5). Instead of attributing the bilingual advantage to bilingualism per se, the authors ascribe their results to the cultural backgrounds of the speakers. The importance of acculturation and biculturalism was also stressed by Laketa et al. (2021), who define the relation between acculturation and bilingualism as bidirectional, since a "higher and more balanced degree of bilingualism is likely to result in more successful acculturation in a host society, and a more bicultural orientation in turn […]" (p.45). It is clear that the observed bilingual effects may interact with environmental factors, and even possibly be explained by them (Yang et al. 2011). Another name under which sociocultural influence might come to light is ethnicity. Morton & Harper (2007), for instance, point out that most studies on Canadian bilinguals were conducted comparing

immigrant bilinguals and non-immigrant monolinguals; a comparison invested with considerable implications about the societal status of the languages at play and the way they are used (cf. the notion of emotional diglossia; Duñabeitia, 2017).

Last, an interesting observation that emerges from our analysis concerns the "null effect" group of studies. While some studies did not find any effect of bilingualism, others stressed the use of different cognitive strategies by monolingual and bilingual participants. Regardless of finding or not finding statistically significant differences in terms of task performance, it is important to highlight that bilingual experience *can* impact the use of specific cognitive strategies instead of others (cf. Bialystok et al., 2005a; Antoniou et al., 2013; Vaughn et al., 2018). The failure to find significant differences between monolinguals and bilinguals may be ascribed to factors other than sociolinguistic or cognitive variables, such as task structure and/or task demands (e.g. Lee et al., 2000). What can be drawn from these results is that being bilingual, with all the aforementioned sociolinguistic variables that bilingualism entails, may affect the way in which a person interacts with linguistic and non-linguistic input, and this in turn may inform processing strategies that may be differently employed by monolingual and bilingual speakers/signers.

5. Outlook

To conclude, the main findings of the present review support the relevance of a sociolinguistic theory of bilingual effects. Through the analysis of 368 studies, we have determined the occurrence of different sociolinguistic variables responsible for bilingual effects in more than 73% of our pool of data. Proficiency, language exposure, language use, communicative context, and sociolinguistic environment are the key factors behind bilingual effects, together with sociodemographic factors such as age, gender, and SES. Through adopting a social-based perspective, future studies on bilingual effects may strengthen their explanatory power by taking into account the dense network of sociolinguistic and environmental factors that characterize the bilingual experience and make bilingualism a gradient phenomenon. The take-home message is that sociolinguistic variables cannot impersonate secondary roles but should rather be acknowledged for their influence on results from tasks that are deemed as measuring primarily cognitive outcomes. This conclusion advances our understanding of bilingualism by showing that bilingualism, as a spectrum of dynamic experiences, cannot be isolated neither from other cognitive functions (Hakuta, 1987; Baker, 2011), nor from the social environment that nourishes it.

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