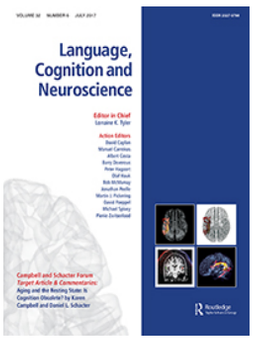

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REGULAR ARTICLE

Revisiting the bilingual advantage in attention in low SES Greek-Albanians: does the level of bilingual experience matter?

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ABSTRACT

The replicability of findings supporting a bilingual advantage in cognitive control has been questioned lately, with socioeconomic status (SES) and bilingualism type (e.g. early-late, dominant-balanced) as suggested confounding variables. It has lately also been argued that bilingual experience (switch cost asymmetry – SCA between the languages), might correlate with interference control. We further investigated this, with a homogeneous group of 45 young bilingual adults. Participants were carefully matched with 45 Greek-speaking monolinguals on age, gender, SES (mostly low), and non-verbal intelligence, and they were given the Attentional Network Test task and a language-switching task measuring SCA. The factor language group did not interact with congruency or cueing. Finally, conflict resolution did not correlate with SCA. Findings are discussed in relation to the present samples' characteristics and evidence suggesting an underrepresentation of the bilingual advantage in lower SES bilinguals.

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Bilingualism; conflict resolution; SES; language experience; adults

The bilingual population has had a significant increase of 140% since 1980 due to globalisation and cultural openness, which characterise today's societies (European Commission, 2006). Almost half of the population uses at least two languages and many more are in the process of becoming bilinguals (Bhatia & Ritchie, 2013), mostly due to immigration. The socio-political importance of this phenomenon has been echoed by increased research interest over the last years in bilingualism and its influences in language-related, as well as non-linguistic cognitive processes.

In terms of linguistic processing, research evidence is consistent about a few adverse effects associated with learning two languages; bilinguals of different ages have often been found to perform worse than monolinguals in language processing tasks (for a review see Rivera Mindt et al., 2008), such as grammar and syntax tasks (see Bialystok, 2009), or in naming tasks, indicating disadvantages in lexical competence (Gollan, Montoya, & Werner, 2002; Gollan, Montoya, Cera, & Sandoval, 2008; Ivanova & Costa, 2008; Sorace, 2011).

Research evidence is not as consistent, however, with regard to positive effects of bilingualism on cognitive development and performance. Initially, studies seemed to demonstrate that learning and controlling different languages in the everyday life setting have positive effects on cognitive performance (e.g. Bialystok, 2006; Bialystok & Craik, 2010; Festman, Rodriguez-Fornells, & Münte, 2010; Hernández, Costa, Fuentes, Vivas, & Sebastián-Gallés, 2010; Kharkhurin, 2010; Poulin-Dubois, Blaye, Coutya, & Bialystok, 2011). The majority of relevant positive findings stem from studies on *Executive Functions* (EFs), such as conflict resolution and resistance to distractor interference (see Friedman & Miyake, 2004), mental set shifting or task switching, or updating (Miyake et al., 2000). Specifically, bilingual adults performed better than monolinguals in EFs tasks such as the *Stroop* task (Bialystok, Craik, & Luk, 2008; Mohamed Zied et al., 2004), the flanker task (Costa, Hernández, & Sebastián-Gallés, 2008, 2009), and the Simon task (Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok & De Pape, 2009).

Explanations offered to account for the observed "bilingual cognitive advantage", are based on the fundamental idea that the need to control two languages in the everyday communication of bilinguals serves as a type of cognitive training, which transfers to non-linguistic, executive control tasks too. There is general agreement in the literature that both languages are active in the bilingual mind, even when only one language is actually used in a given communication context (Colomé, 2001; Costa & Caramazza, 1999; Costa, Miozzo, & Caramazza, 1999; Dewaele, 2001; Gollan & Acenas, 2000; Green, 1998; Martin, Dering, Thomas, & Thierry, 2009; Thierry & Wu, 2007; van Heuven, Schriefers, Dijkstra, & Hagoort, 2008). Given the simultaneous activation of the two languages, a bilingual individual would be

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expected to continuously resist intrusions from the non-relevant language in order to achieve fluent communication (production and comprehension) in the target language. A question stemming from this suggestion is whether the effective control of both languages is achieved by differential activation of the target language (see Costa, 2005 for a discussion) or by selective activation of the target language and suppression of the other language to avoid interference (Abutalebi & Green, 2008; Green, 1996). There is an ongoing debate on this issue, with most explanations of positive effects, however, favouring the latter inhibitory control model. Other explanations offered for the bilingual advantage have focused on qualitative and quantitative differences between language groups in monitoring and resource allocation skills in response to task demands. In the Morales, Gómez-Ariza, and Bajo (2013) study, for example, the bilingual advantage was only evident in conditions that required the highest adjustment between monitoring (proactive) and inhibitory (reactive) control. In line, in a follow-up ERP study, Morales, Yudes, Gómez-Ariza, and Bajo (2015) argued that bilingualism facilitates an effective adjustment between both cognitive control components, and suggested the adoption of a multi-component perspective in better understanding the cognitive benefits of bilingualism.

In an attempt to provide a clearer insight into the extent and diversity of the effects of bilingual experience on cognitive development and performance, Adesope, Lavin, Thompson, and Ungerleider (2010) have recently conducted a meta-analysis. The researchers suggested a moderate positive overall effect of bilingualism on measures of executive-attentional control (producing the largest effect), working memory, metalinguistic awareness, and abstract and symbolic representation skills. Researchers noted, however, that overall mean effect sizes significantly varied among studies, depending on the types of cognitive tasks used, as well as on samples' characteristics.

The enthusiasm about a positive effect of bilingualism on cognitive performance has been recently followed, however, by progressively increasing negative or inconsistent evidence, as well as with scepticism regarding the design of relevant studies and the potential influences of confounds (see von Bastian, Souza, & Gade, 2016). In a review of empirical data, for example, Hilchey and Klein (2011) suggested that there is little, or only sporadic, evidence to suggest a bilingual inhibitory control advantage on non-linguistic interference tasks (e.g. conflict resolution tasks). As noted, bilinguals seem to enjoy a more widespread cognitive (executive processing) advantage, that is observable on their superior, often by similar magnitude, performance on both compatible and incompatible trials. As Hichley and Klein further note, however, only few studies have reported significant effects of bilingualism on traditional tasks of non-linguistic inhibitory control processes. Other researchers have also failed to replicate the bilingual advantage in studies involving different populations: For instance in Paap and Greenberg (2013), where bilingual and monolingual young adults were compared on 15 indicators of cognitive processing, and in Duñabeitia et al. (2014), where bilingual and monolingual children were compared in Stroop task versions (see also Antón, Fernández García, Carreiras, & Duñabeitia, 2016, for a lack of replication with older adults). In recent reviews, Paap, Johnson, and Sawi (2015) also conclude that there is no compelling evidence for an inhibitory advantage in bilinguals; whereas Hilchey, Saint-Aubin, and Klein (2014) additionally note that evidence for a more global response time (RT) advantage has also evaporated.

Although, the debate on the existence or not of a bilingual advantage is still open and there are strong opposing views in the literature, as it is usually the case, we have learned important lessons from this public research discussion. Bilingualism is a complex phenomenon and there is great heterogeneity among bilingual individuals across the world. Thus, it has been suggested that lack of careful control for confounding variables that may co-vary with EFs, such as culture, socioeconomic status (SES), and immigration status, might account for the contradictory findings in the literature (see Paap et al., 2015). Morton and Harper (2007), for example, were among the firsts to point out the importance of controlling for SES in bilingual studies. In their study, they failed to find differences in the Simon task between two groups of bilingual and monolingual adults, who were matched on SES. As already suggested, for example, individuals of low SES might have fewer opportunities to engage in activities which can, in the long term, influence cognitive processes, as compared to people from high SES backgrounds (see Magnuson & Duncan, 2006). In line, Mezzacappa (2004) has shown that children of higher SES were superior than those of lower SES in measures of executive attention, alerting, and orienting (provided by the Attentional Network Test – ANT).

SES, however, has not been controlled for in several studies that have reported positive effects of bilingualism on cognitive performance (e.g. Bialystok et al., 2004, 2008; Bialystok, Barac, Blaye, & Poulin-Dubois, 2010; Bialystok & Martin, 2004; Carlson & Meltzoff, 2008). The few studies, with children and adults, which took SES into account offer evidence that is greatly inconsistent, possibly due to the fact that other factors

were left uncontrolled. Calvo and Bialystok (2014), for example, found that bilingualism and SES contributed independently to young children's performance in executive function tasks. However, researchers included children that spoke English and one other language in their study, thus not controlling for neither L1–L2 similarity, nor for the origin of the non-English speaking parent/s (as also in the case of the Bialystok et al., 2010 study with bilingual children at the preschool phase). This might have allowed for cultural driven influences on the language and cognitive development of the bilingual child (e.g. related to the home routines and practices) that were not controlled for. Additionally, L1–L2 would be important to control for, since there are suggestions that the more similar the orthographies in the languages spoken by bilinguals (Coderre & van Heuven, 2014), the easier the cross-linguistic transfer (Bialystok, Luk, & Kwan, 2005; Koda & Zehler, 2008), but potentially, the greater the inhibition demands set in suppressing the language that is less relevant to a given communication context.

Recently, however, a few studies that have carefully controlled for potential confounds, have offered evidence pointing to the opposite direction. In line with Morton and Harper's (2007) findings regarding the Simon task (see above), Antón et al. (2014) also failed to demonstrate differences between 180 bilingual children and a group of 180 carefully matched monolinguals in the ANT task and the indices associated with the individual attention networks. In our lab, we also failed to find significant differences between two homogeneous groups of Greek-Albanian early bilingual ($N = 54$) and Greek monolingual children ($N = 56$), who were carefully matched on SES (low SES level, given its prevalence in the specific population), in the ANT and a pragmatic ability measure (Ladas, Carroll, & Vivas, 2015). To our knowledge there is only one another study with bilinguals from particularly low SES background. In this study, de Abreu, Cruz-Santos, Tourinho, Martin, and Bialystok (2012) concluded that the bilingual advantage is not confounded by socioeconomic and cultural factors; that is, they found a bilingual advantage in control processes (selective attention and interference suppression) but not in working memory and abstract reasoning tasks. However, it seems that other cultural (e.g. country of residence) and language exposure factors were left uncontrolled in this study. Thus, the Portuguese–Luxenburgish bilinguals were living in Luxembourg and were attending schools that exposed them to foreign language/s, whereas monolinguals were recruited in Portugal, where foreign language instruction is not part of the curriculum.

Despite this recent wave of scepticism about the suggested bilingual advantage in cognitive performance, it seems important that researchers continue to explore in which contexts such an advantage is observed, attenuated, or even eliminated, as well as what exact factors may modulate the effects of bilingual experience on cognition (see Green, 2011). Such examinations are expected to inform theories of bilingualism, as well as policy making that relates to its implications (e.g. in the educational setting). Pursuing a relevant research line, in the present study, we carefully matched 45 Greek-Albanians with Greek monolinguals adults on SES, gender, age, and intelligence. Participants were given the *ANT,* providing measures of orienting of attention to space, alertness, and executive attention (Fan, McCandliss, Sommer, Raz, & Posner, 2002). It should be noted, that although, authors that advocate for a bilingual advantage, agree that it is mostly observed in tasks tapping executive control and conflict resolution (see Adesope et al., 2010; Bialystok, 2009), and in a less well-defined category of tasks that are assumed to tap flexible mental shifting, metacognition, and monitoring (see Adesope et al., 2010; Kemp, 2007; Prior & MacWhinney, 2010), there are mixed opinions on whether bilingualism affects other, non-executive control processes, such as visuospatial orienting and alertness (Costa et al., 2008; Hernández et al., 2010; Marzecová, Asanowicz, Krivá, & Wodniecka, 2013; Tao, Marzecová, Taft, Asanowicz, & Wodniecka, 2011). The logic behind assessing these two other attentional networks is based on behavioural and neuroimaging studies showing interactions between the three networks (Callejas, Lupiánez, & Tudela, 2004; Fuentes, Vivas, Langley, Chen, & Gonzlez-Salinas, 2012). For instance, Callejas and colleagues (Callejas, Lupianez, Funes, & Tudela, 2005) reported larger interference effects when the incongruent trials were preceded by an alerting cue, as compared to a non-alerting cue condition. Also, they reported larger interference effects in valid spatial cue condition, relative to an invalid spatial cue condition.

It might therefore be the case that a potentially positive effect of bilingualism on the executive attention network has a knock on effect on the function of the orienting and alerting networks. To our knowledge, only five studies have investigated all three aspects of the attentional network in adult bilinguals, providing, however, mixed results. For instance, Costa et al. (2008) found that bilinguals outperformed monolinguals on conflict resolution and alerting measures in the ANT, although no difference was found on trials measuring attentional orienting to space (see also Hernández et al., 2010, showing no effect of bilingualism in orienting using an inhibition of return task). The same pattern of results was reported by Marzecová et al. (2013) in a study employing the Lateralised Attentional networks

Task (LANT); that is, they found a significantly smaller conflict effect and a larger alerting effect in bilinguals relative to monolinguals, but no significant differences in orienting scores. Using the same task (LANT), Tao et al. (2011), however, did not find differences between 66 bilinguals (36 early and 30 late bilinguals) and 34 monolinguals in neither the alerting, nor the orienting scores. To the best of our knowledge, only one study has found a significant effect of bilingualism on attentional orienting (Colzato et al., 2008). Using a spatial cueing paradigm with varying SOA (Stimulus Onset Asynchrony) values, the authors found a significant type of cue (valid vs invalid) by language group interaction. However, a closer look at the interaction shows facilitatory effects in short SOAs only in the monolingual participants; whereas inhibitory effects at longer SOA values were found only in the bilingual participants. Thus, the key result here is not that bilinguals had a greater inhibitory effect, but the failure to replicate inhibition of return in the monolingual group. Paap et al. (2015) have ringed the bell about the importance of interpreting rightly significant two-way interactions in bilingual studies, demonstrating how often they are wrongly interpreted as evidence of a bilingual advantage. Summing up, existing evidence does not support a bilingual advantage in attentional orienting, but there are at least two studies reporting a bilingual effect in alerting scores.

In addition to the ANT task, we also employed a language-switching task, so as to obtain a more objective measure of language proficiency, as the latter is indicated by the automaticity in switching between two languages. Green (2011) has suggested that the "behavioural ecology of bilingual speaker" may modulate the bilingual advantage effect; that is, different bilinguals might be exposed to different language control demands. For instance, a bilingual who is raised by parents who speak a different language and needs to constantly switch between both languages faces very different language demands relative to a bilingual individual who speaks the two languages in different contexts (e.g. one language at home and the other at work). Thus, we expect that the level of proficiency (automaticity in lexical access) obtained in the two languages and the experience in switching between them should affect the magnitude of the asymmetry in switching between both languages (Meuter & Allport, 1999). We thus aimed to use this measure to test whether individual differences within the bilingual group in proficiency and automaticity in switching between the two languages is associated with the efficiency in resolving conflict, as well as with performance in the other two attentional networks tapped by the ANT. In a previous study in our lab, involving Greek-speaking monolingual and Greek-Albanian speaking bilingual children (Ladas et al., 2015), we did not find significant language group differences in the ANT task measures; however, when controlling for age (Study 1; 6-to-12 year old children), a significant correlation was observed between the magnitude of the conflict effect and the absolute switch cost (ASC) asymmetry (SCA; i.e. mean switch-to-L2 RTs subtracted from mean switch-to-L1 RTs).

Based on the above-mentioned, we stated the following hypotheses:

If learning and controlling two languages in everyday life does have an effect on EFs and alerting of attention, as some previous studies have suggested, we should find a significant difference between the group of Albanian–Greek bilinguals and Greek monolinguals, even when eliminating the potential confound of SES.

Also, based on our previous work with bilingual children, if the bilingual experience in everyday life (the proficiency in L2 and the training in switching between language because of everyday language control demands) modulate the bilingual effect, we should find a significant correlation between the absolute SCA in the language task and the magnitude of the conflict effect in the ANT task.

Method

Participants

Participants were 45 bilinguals, speaking Greek and Albanian, and 45 Greek monolingual adults, living in both urban and rural areas of Northern Greece. Most of the bilingual participants were either born in Greece or came to Greece in their childhood (when their parents migrated to Greece from Albania); only few participants (13) came to Greece in late adolescence or early adulthood phases (see Table 1).Albanian was the language

Table 1. Summary of participants' demographics and linguistic characteristics in the monolingual and bilingual groups.

	Monolinguals ($N = 45$) *M* (SD)	Bilinguals ($N = 45$) *M* (SD)
Age (years)	29.67 (9.49)	27.29 (6.96)
SES[a]	5.56 (1.74)	5.47 (1.89)
G-WAIS Voc[b]	48.71 (8.62)	40.16 (16.25)
A-WAIS Voc[c]	–	20.40 (17.07)
Raven's CPM	47.62 (7.57)	47.36 (7.18)
L2 onset[d]	–	9.95 (8.36)
No. of years in Greece	–	17.25 (5.10)

[a]SES: 1–7 = low SES, 8–12 = middle SES, ≥13 = high SES.
[b]*G-WAIS Voc.* = raw scores on the Greek version of the WAIS Vocabulary subscale.
[c]*A-WAIS Voc.* = raw scores on the Albanian version of the WAIS Vocabulary subscale.
[d]L2 onset = the mean age (in years) at which participants were exposed to Greek.

predominantly used in the family environment, whereas Greek was spoken with friends and peers at academic, professional, or social settings.

Bilinguals were strictly matched with the monolinguals on age, gender (16 males and 29 females in each group), performance on the *Raven's Standard Progressive Matrices Test* (Raven, 1958), and SES level (see Table 1 for a summary of demographic and linguistic characteristics of the participants). Specifically, an independent samples *t*-test confirmed appropriate matching, with bilinguals ($M = 27.58$, SD = 6.83, range: 18–48) not differing significantly from monolinguals ($M = 29.42$, SD = 9.67, range: 18–55) on their age in years [$t(88) = -1.045$, $p = .299$]. Similarly, an independent samples *t*-test did indeed fail to reveal differences between bilinguals ($M = 47.36$, SD = 7.18, range: 21–57) and monolinguals ($M = 47.62$, SD = 7.57, range: 23–58) on the *Raven's Standard Progressive Matrices Test* [$t(88) = -.171$, $p = .864$].

Finally, SES was measured with a questionnaire (Ladas et al., 2015) developed on the basis of those used in relevant studies with bilinguals (see Abedi, Lord, & Plummer, 1997; Costa et al., 2008; Garratt & Kelly, 2008; Gullberg & Indefrey, 2003). The questionnaire provided a composite SES measure based on ratings of (a) educational level (from 0-did not finish elementary school- to 5-university or higher-level graduate), (b) professional type (1 = blue collar, 2 = white collar), and (c) position in occupation (from 1-worker/unskilled- to 5-executive member of public or private sector). Similar categorisations have been repeatedly used by researchers that have assessed SES level in Greek samples (for a review see Economou & Nikolaou, 2005; see also Ladas et al., 2015). The SES level of each participants was calculated by summing up the scores on those three sections and applying specific cut-off scores for inclusion in low SES status (2–7), middle status (8–12), and high SES (13 or greater) status groups. Specifically, there were 38 participants of low SES level and 7 of middle SES level in each group. An independent samples *t*-test confirmed appropriate SES level matching, with bilinguals ($M = 5.47$, SD = 1.89, range: 2–9) not differing significantly from their monolingual counterparts ($M = 5.49$, SD = 1.82, range: 2–9) on their total SES scores either [$t(88) = -.057$, $p = .955$].

Participants were also assessed on the productive vocabulary subtest (requiring word definitions) of the *Wechsler Adult Intelligence Scale* (WAIS III; Wechsler, 1997; adapted in Greek and standardised by Koulakoglou, 1998). The WAIS has been validated in the Greek population, but not in the Albanian population. Thus, the Greek vocabulary test was translated and back-translated to Albanian by psychologists who were bilingual in Greek and Albanian. The same psychologists scored the bilingual participants on the Albanian version of the vocabulary test, based on recorded responses. An independent samples *t*-test revealed significantly higher proficiency of the monolingual ($M = 48.71$, SD = 8.62, range: 29–60), as compared to the bilingual participants ($M = 40.16$, SD = 16.25, range: 4–58) in Greek vocabulary [$t(88) = -3.12$, $p = .002$]. Moreover, a paired samples *t*-test showed that the bilingual participants scored higher on Greek, rather than on the Albanian productive vocabulary test ($M = 20.40$, SD = 17.07, range: 4–57; $t(44) = -6.004$, $p = .000$).

Measures and procedure

The language-switching task

The language-switching task was based on the work of Meuter and Allport (1999). They were the first to demonstrate that the processes of language switching in bilinguals are fundamentally similar to non-linguistic processes of task switching. That is, RTs are longer for switch than non-switch trials, and most importantly, when the bilingual participant is required to switch from the non-dominant language (L2) to the dominant language (L1), an asymmetrical switch cost (i.e. a larger RT cost) is elicited (as compared to when switching from L1 to L2). This cost is attributed to more inhibition that is required to suppress the dominant than the less dominant language (see also Yeung & Monsell, 2003). In cases of balanced bilinguals, however, SCA is abolished.

The task provides valuable information about the level of bilingualism and specifically, proficiency and automaticity in switching between the two languages. The latter has been overlooked in most previous studies, which have instead used self-report questionnaires, thus providing more subjective measures of bilingual proficiency (see Bialystok & Martin, 2004; Bialystok et al., 2004, 2008).

The version used in the present study was developed by Ladas et al. (2015), in the context of a relevant bilingual study with Greek-Albanian children. Bilingual participants were asked to respond as quickly and accurately as possible to yellow digits (from 1 to 9), presented one at a time on a background showing either the Greek or the Albanian flag. Participants were required to read aloud each digit presented in the language primed by the flag. The stimuli were presented in pseudorandom order, however, without repetition of the same number in adjacent trials. A microphone, connected to a voice key, was used to record participants' responses (accuracy was recorded by the experimenter, via the keyboard).The task consisted of one practice block of 10 trials, followed by two experimental blocks

of 475 trials each. There were two types of trials: (a) the *non-switching* trials (70% of the total trials), where two or more trials in a row required responses in the same language, and (b) the *switching* trials (30% among the total), requiring a response in a different language from the one used in the previous trial. Half of the switch and non-switch trials in each block required a response in Greek and half in Albanian. There was a practice section in the beginning of the task and a break in between the experimental blocks. The whole process lasted approximately 20 minutes for each participant. The automaticity in switching between the two languages was indicated by the difference between the mean RT of each participant in the trials that required switching from Greek to Albanian minus his/her mean RT when switching from Albanian to Greek lag trials (only correct responses were taken into account).

The ANT task

The adult version of the ANT was used, as adopted from Fan et al. (2002). Participants were told to keep their eyes on the fixation cross (+) throughout the experiment. In each trial, a warning cue appeared for 100 ms. There were four different types of warning cues used: a spatial cue, a double cue, no cue, and a central cue. In the spatial cue condition, an asterisk was presented at the upcoming location of the target array. In the double cue condition, two asterisks (one above and one below fixation) were presented prior to the target appearing. The no cue and central cue conditions were control conditions for the double cue and spatial cue conditions, respectively. After an interval of 400 ms, the target array was presented above or below the fixation point. The target was an arrow, pointing either left or right. The target was always presented centrally, alone or flanked by four identical arrows, according to the condition: namely, arrows pointing towards the same direction as the target in the congruent trials, or towards the opposite direction in the incongruent trials.

Each trial was thus a combination of one of the 4 cueing conditions (central cue, alerting cue, spatial cue, no cue) with one of the 3 flanker conditions (congruent, incongruent, neutral), and was presented 24 times (8 times in each block). The experiment included 24 practice trials, and 3 experimental blocks with 96 trials (feedback was provided only for the practice trials). In total, 288 experimental trials were presented, in random order. Completion time was approximately 25 minutes. According to Fan et al. (2002) the independent scores for the efficiency of the three attentional networks can be calculated by subtracting (a) mean RT for no cue trials from mean RT in those with a double cue (alerting network score), (b) mean RT for trials with central from mean RT in those with a spatial cue (orienting network score), and (c) mean RT in incongruent from mean RT in congruent trials (executive attention network or conflict score; in all cases, mean RTs were calculated on the basis of correct trials only).

The study was approved by the Ethics Committee of the University of Sheffield. Each participant was tested individually, in a quiet room. A short description of the study, by withholding the exact aims so as to avoid demand characteristics, was firstly given, followed by the informed consent form. A self-report questionnaire was developed based on previous studies on bilingualism (Abedi et al., 1997; Brown, Brown, & Eggett, 2009; Costa et al., 2008; Portocarrero et al., 2007) in order to gain detailed information about the participants bilingual background and their SES (see also Participants section). The questionnaire was followed by the intelligence and vocabulary tests. Finally, participants completed the language-switching and the ANT tasks (developed in e-prime software and presented on a 15-in laptop PC), in counterbalanced order. For both tasks, instructions were given orally and in written, and the participants were given enough time to ask for possible clarifications. Testing lasted approximately 90 minutes for the monolinguals and 105 minutes for the bilingual participants.

Results

ANT task

Response times

Mean response times were submitted to a mixed 2 × 4 × 3 ANOVA with group (monolinguals and bilinguals) as the between subject factor, and cueing (no cue, central cue, double cue, and spatial cue) and congruency (congruent, incongruent, and neutral) as the within-subject factors (see Table 2). Results showed significant main effects of group, cueing and congruency, [$F(1, 88) = 4.22$, $p = .043$, $\eta^2 = .046$], [$F(3, 267) = 128.03$, $p < .0001$, $\eta^2 = .593$] and [$F(2, 176) = 623.93$, $p < .0001$, $\eta^2 = .876$], respectively. That is, overall bilingual participants (595 ms) were slower than monolingual participants (554 ms). In addition, Bonferroni post-hoc comparisons showed significant differences between all cueing ($Mean_{No} = 597$, $Mean_{Double} = 571$, $Mean_{Center} = 581$, and $Mean_{Spatial} = 548$ ms) and congruency ($Mean_{Congruent} = 542$, $Mean_{Incongruent} = 653$, and $Mean_{Neutral} = 528$ ms) conditions, $ps < .0001$. Finally, there was also a significant cueing by congruency interaction, $F(6, 528) = 11.40$, $p < .0001$, $\eta^2 = .115$. In order to analyse this interaction, we calculated the conflict effect (RTs Incongruent – RTs Congruent) for each cueing condition, and submitted

Table 2. Mean response times and standard deviations as a function of language group, Cue type, and Flanker type.

		Cue type			
Flanker type	Language group	No cue *M* (SD)	Central cue *M* (SD)	Double cue *M* (SD)	Spatial cue *M* (SD)
Congruent	Monolinguals	543 (77)	526 (93)	517 (87)	502 (86)
	Bilinguals	592 (103)	563 (104)	550 (97)	542 (105)
Incongruent	Monolinguals	646 (106)	649 (102)	633 (109)	590 (109)
	Bilinguals	694 (116)	690 (126)	681 (120)	640 (120)
Neutral	Monolinguals	537 (77)	511 (80)	504 (79)	489 (79)
	Bilinguals	568 (105)	547 (95)	543 (95)	526 (94)

mean conflict effects to a one-way repeated measures ANOVA with cueing as the within subject factor. Results showed a significant main effect of cueing $F(3, 267) = 14.26$, $p < .0001$, $\eta^2 = .138$. Bonferroni post-hoc comparisons showed that the magnitude of the conflict effect was significantly smaller in the spatial cue condition (93 ms of effect) as compared to the centre (125 ms of effect) and the double cue (123 ms of effect) conditions, $ps < .0001$. Also, the magnitude of the conflict effect in the no cue condition (102 ms of effect) was significantly smaller than the ones in the double cue and the centre cue conditions, $p = .002$ and $p = .006$. The other comparisons did not reach statistical significance, $p > .1$.[1]

Accuracy

Mean accuracy data were submitted to a mixed $2 \times 4 \times 3$ ANOVA with group as the between-subject factor, and cueing and congruency as the within-subject factors. Results showed a significant main effect of congruency [$F(2, 176) = 51.710$, $p < .0001$, $= .370$]. Bonferroni post-hoc comparisons showed significant differences between the incongruent (96.5% accuracy) and the congruent (99.5% accuracy) and neutral (99.3% accuracy) conditions, $ps < .0001$. No other effects, neither their interactions reached statistical significance.

Independent sample tests were conducted to compare both language groups on each of the attentional network scores (Alerting, Orienting, and Conflict). To allow us to study separately the three attentional networks assessed by the ANT, discrete scores were computed for each network (Conflict score = Incongruent RTs – Congruent RTs; Alerting score = Double cue RTs – No cue RTs; and Orienting score = Spatial cue RTs – Central cue RTs; for correct trials only, in all three cases). Results showed that Bilinguals and Monolinguals participants did not significantly differ on any of the scores; Conflict ($Bilingual_{Mean} = 115$ ms; $SD = 44$ vs $Monolingual_{Mean} = 110$ ms, $SD = 37$), $t(88) = .635$, $p = .527$, $d = .2$; Alerting ($Bilingual_{Mean} = 32$ ms, $SD = 30$ vs $Monolingual_{Mean} = 27$ ms, $SD = 25$), $t(88) = .795$, $p = .429$, $d = .1$; and Orienting ($Bilingual_{Mean} = 35$ ms, $SD = 30$ vs $Monolingual_{Mean} = 30$ ms, $SD = 27$), $t(88) = .795$, $p = .429$, $d = .2$. We further tested differences on each attentional network mean score with the Bayesian Null Hypothesis Testing (Rouder, Speckman, Sun, Morey, & Iverson, 2009). The lack of significant differences between Bilinguals and Monolinguals on Conflict, alerting and orienting scores was also supported by the Bayesian *t*-test; BF_{01} = 3.792 for the conflict scores and BF_{01}= 3.429 for both the Alerting and Orienting scores.

Language-switching task

Correct mean naming latencies were submitted to a two by two repeated measures ANOVA with Trial type (Non-Switch vs Switch) and Language (L1-Albanian- vs L2 – Greek-) as within subject factors (see Figure 1). Only the main effect of trial reached statistical significance, $F(1, 44) = 115.825$, $p < .0001$. That is overall naming latencies were higher for switch trials (836 ms) as compared to Non-Switch trials (748 ms), an overall switch cost effect of 88 ms. The main effect of language and the Trial type by language interaction did not reach

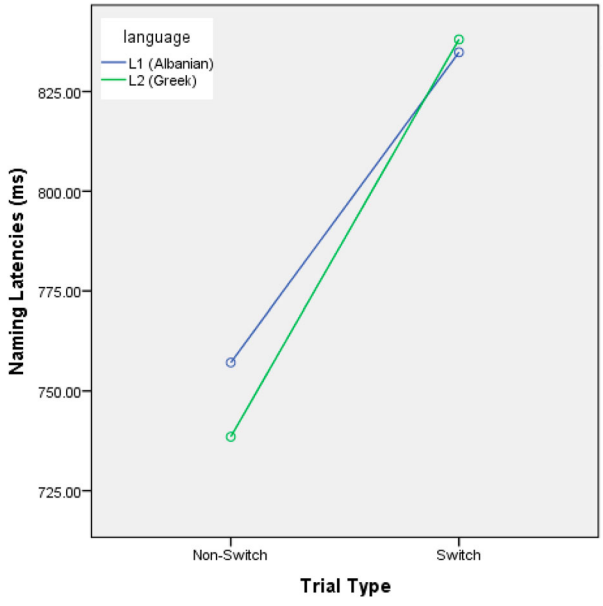

Figure 1. Mean naming latencies in language-switching task as a function of trial type (non-switch and switch trials) and language (L1 – Albanian- and L2 – Greek-) in the bilingual group.

Table 3. Pearson correlation coefficients among the ANT measures, the overall RTs, and the ASC in the language task.

	1	2	3	4	5
1. Absolute switch cost	–	−.050	−.041	−.037	−.131
2. Conflict resolution		–	−.103	.080	.349*
3. Alerting			–	.030	.068
4. Orienting				–	.210
5. Overall RT					–

*$p = .019$.

statistical significance [$F(1, 44) = .646$, $p = .426$ and $F(1, 44) = 1.326$, $p = .256$, respectively].

To test the relationship between the three attentional networks, the overall RTs and the degree of bilingualism (as assessed by the language-switching task), we employed a score of the absolute SCA (mean switch-to-L2 RTs were subtracted from mean switch-to-L1 RTs). That is, an absolute SCA of 0 would indicate balanced bilingualism. Contrary to our prediction, the Pearson correlation coefficients did not demonstrate any significant correlations between the SCA (Mean = 56.57; SD = 53.07), the conflict, alerting, orienting scores, and overall RTs (all ps > .05; see Table 3).

Secondary analyses

Since some of our bilingual participants had immigrated to Greece in late adolescent years (see Table 1), we conducted further analyses including only early bilinguals (those who were born in Greece or immigrated to Greece during the preschool or the elementary school years, $N = 31$). As in the total sample analyses, language group did not interact with neither cueing, nor congruency. In this subsample, the trend for an overall slower response time in the bilingual group (555 ms), relative to the monolingual group (529 ms) was still present; however, this difference did not reach statistical significance any more, $F(1, 60) = 2.230$, $p = .141$. Independent sample t-tests comparing the two language groups on the Conflict [$\text{Bilingual}_{\text{Mean}} = 112$ ms; SD = 43 vs $\text{Monolingual}_{\text{Mean}} = 105$ ms, SD = 31, $t(60) = .810$, $p = .421$], Alerting [$\text{Bilingual}_{\text{Mean}} = 35$ ms, SD = 27 vs $\text{Monolingual}_{\text{Mean}} = 39$ ms, SD = 23, $t(60) = 1.01$, $p = .317$], and Orienting [$\text{Bilingual}_{\text{Mean}} = 35$ ms, SD= 28 vs $\text{Monolingual}_{\text{Mean}} = 25$ ms, SD = 24, $t(60) = 1.49$, $p = .14$] scores, did not yield significant effects either.

Discussion

The aim of this study was to further investigate if bilingualism has an effect in a non-linguistic task of executive control, and in alerting and orienting attentional network scores, when both language groups are carefully matched on SES. Furthermore, we wanted to investigate whether the bilingual experience, that is the proficiency in both languages and the training in switching between languages, would correlate with the bilingual's ability to resolve conflict. Contrary to our predictions we did not find any evidence of a bilingual advantage in a sample of 45 Albanian-Greek bilinguals and 45 Greek monolinguals. That is, the factor language group did not interact with any of the other factors (congruency or cueing), even when we repeated the analyses in a subsample of bilinguals ($N = 31$) who were more strictly defined as early bilinguals based on L2 onset (year of acquisition). Furthermore, we did not find any significant correlation between the absolute SCA and the conflict scores (neither between SCA and the alerting and orienting scores). Although, we found that the bilingual participants were overall significantly slower in the ANT task as compared to the monolingual group, this effect was no longer significant in the subsample of early bilinguals.

The lack of a bilingual advantage in executive attention and alerting scores is at odds with several previous studies that have reported better performance in bilingual, relative to monolingual participants using a similar – flanker-task (Bialystok & De Pape, 2009; see also Emmorey, Luk, Pyers, & Bialystok, 2008) or the ANT task (Costa et al., 2008, 2009; Marzecová et al., 2013; Tao et al., 2011). However, it is in agreement with recent studies that have failed to find a bilingual advantage in cognitive performance, when SES was strictly controlled for (Duñabeita et al., 2014; Hilchey & Klein, 2011; Morton & Harper, 2007; Paap & Greenberg, 2013). In line with these later studies, our findings suggest that when potential confounding factors, that co-vary with EFs are controlled for (intelligence and SES), bilingualism does not seem to exert significant effects on EFs, and specifically, on conflict resolution, orienting, and alerting.

Interestingly our bilingual sample had many of the characteristics suggested to positively modulate the bilingual advantage. Specifically, there are suggestions that the more similar the orthographies in the languages spoken by bilinguals (Coderre & van Heuven, 2014), the easier the cross-linguistic transfer (Bialystok et al., 2005; Koda & Zehler, 2008), but potentially, the greater the inhibition demands set in suppressing the language that is less relevant to the communication context. Actually, the bilingual participants spoke two languages, Albanian and Greek, which are considered to be rather similar linguistically. Specifically, they are both characterised by clear rules determining the modifications words undergo in relation to their different grammatical functions in particular contexts (see Holton, Mackridge, & Philippaki-Warburton, 1997). For example, in both

languages, there are word endings indicating the grammatical case of nouns or adjectives, or verb endings, forming the conjugation of verbs (i.e. how a verb can change to show a different person, tense, number). Greek and Albanian share similar analytical tendencies as well, based on the analysis of the use of prepositions, conjunctions, articles, etc, in each language. Moreover, five out of the seven vowels in Albanian, are used in Greek as well, whereas both languages are characterised by regularity in terms of grapheme-phoneme correspondence. There are finally, many Greek word loans in the Albanian language (see Spyrou, 2003 for analysis and discussion of the languages' similarities). However, despite the L1/L2 similarity in our bilinguals' case, which was expected to set greater demands for control to avoid interference, and thus, greater training and transfer to EFs, we did not find significant group differences in the ANT flanker measure of interference control.

Another important characteristic of our bilingual sample is that the majority of the participants had low SES. Could it be the case that an overall hampering effect of low SES on cognition (see Magnuson & Duncan, 2006) masked a bilingual advantage in our sample? We believe that this is rather unlikely since the monolingual group had the same SES level. Future studies may test this hypothesis by manipulating SES status in the same study, while carefully controlling for other factors that may modulate the effect, such as type of bilingualism (e.g. early versus late bilinguals) and the languages spoken, or the country of residence and thus, the cultural-educational context that the language groups are exposed to. Such factors, for example, were not controlled for in one of the few studies conducted with low SES bilinguals, where de de Abreu et al. (2012; see Introduction) reported a bilingual advantage in children, beyond SES effects.

Bialystok, Craik, and Luk (2012) have also suggested that bilingual effects in cognition may not be observed in young adults, who are at the peak of cognitive ability. However, one can hypothesise that this argument does not apply so well to our sample, involving young adults of low SES, due to the detrimental effect that the latter has on cognitive development. We can thus assume that cognitive performance is not at the optimal level in our sample of bilinguals, consequently leaving more space for potential positive effects of bilingualism "training" to be observed.

One novel aspect of our study was the use of a language-switching task to obtain an objective measure of bilingualism experience and training in switching between the languages. In a previous study in our lab with Albanian–Greek bilingual children, we found that the absolute SCA (mean switch-to-L2 RTs were subtracted from mean switch-to-L1 RTs) was positively correlated with the magnitude of the conflict effect (Study 1; Ladas et al., 2015). Although we did not find a significant difference between the language groups in that study, we concluded that this within group finding could be interpreted as the amount of bilingual experience being related to the ability to resolve conflict. That is, the more balanced children were in both languages (as indicated by a smaller or lack of asymmetry in switching cost), the more efficient they would be in resolving conflict in the ANT task.

The specific positive correlation was not replicated in the present study with adults. This discrepancy might be explained on the basis of the overall results obtained from the language-switching task in the two studies. The bilingual children in the Ladas et al. (2015) study showed great heterogeneity in the switch trials (i.e. SD of 738 and 454 when switching to Albanian and Greek, respectively), and had an overall significant asymmetrical switch cost. The extensive range in participants' age (6–12 years), and therefore, the potential diversity in their bilingualism experience (exposure to both languages) might explain the observed heterogeneity. It might have been the case that some of the children in this study spoke mostly Albanian, which was the language spoken at home, since at a younger age there is less exposure to formal schooling and socialising outside the family environment. In line with this suggestion, children were found slower in switching from L2 (Greek) to L1 (Albanian), than vice versa (indicating the dominance of the Albanian language). However, the bilingual adults in the present study seemed both more balanced in the use of the two languages, and less heterogeneous in their switch trials' performance (SD of 132 and 161, for switching to Albanian and Greek, respectively). This may explain the lack of a significant correlation between the absolute SCA and the magnitude of the conflict effect in the present study.

The inclusion of two types of language tasks in the present study, allowed us to more holistically evaluate language proficiency. Specifically, we used a productive vocabulary task (definitions) in both Greek and Albanian (indicating proficiency in relation to word knowledge and accuracy), as well as the above-mentioned language-switching task (indicating fluidity-rapidity in language switching). As Kroll and De Croot (2005) note, language proficiency is determined by both indices. We did not observe a SCA in our bilingual group, although our bilingual participants scored higher on the Greek, rather than the Albanian productive vocabulary test (see Table 1). It should be noted, however, that how balanced bilinguals are in switching between the two languages, is expected to be influenced by the

years spent in a country and thus, the demands set for language switching in everyday life (see Bialystok, 2009). On the other hand, vocabulary knowledge is assumed to be influenced by literacy development and exposure to oral and written language material (see Cain & Oakhill, 2011) in the educational setting. Most of our bilingual participants were born in Greece or migrated to Greece during their preschool or elementary school years, thus, being exposed to the context-related (Greek) language in the educational-academic setting. This could explain why our bilinguals were better at providing word definitions in the Greek, rather than the Albanian productive vocabulary task. However, the monolingual participants were more consistently exposed to Greek in the family and social settings as well (where our bilinguals significantly relied on Albanian instead); this, could well explain why our monolinguals outperformed bilinguals in Greek vocabulary, in line with several relevant findings (see Bialystok, 2009 and Sorace, 2011 for reviews).

The lack of a positive correlation between ASC and conflict resolution could also be interpreted in the light of recent studies which suggest that switching cost might not index inhibitory control in language production (Bobb & Wodniecka, 2013; Christoffels, Firk, & Schiller, 2007; Costa & Santesteban, 2004; see also Declerck & Philipp, 2015 for a recent review). For instance, Costa and Santesteban (2004) have suggested that only low-proficient bilinguals would rely on inhibition to control production of L1 and L2. In support of this hypothesis, the authors did not find a language-switching cost asymmetry in highly proficient bilinguals. Christofells et al. (2007) also failed to find language-switching cost asymmetry in their bilingual sample, and suggested that bilinguals might modulate L1 in mixed language context by means of global inhibition (and not reactive inhibition). In a recent review, Bobb and Wodniecka (2013) concluded that switch cost might indeed be related to language proficiency but in a more complex way than initially thought. They also proposed that other factors, such as switching experience (see also Green & Abutalebi, 2013) and those related to task demands (e.g. type of stimuli) may modulate the pattern of switch cost (a)symmetry in language-switching tasks. Future studies should test these hypotheses by including formal measures of language-switching behaviour (e.g. switching density) and more objective measures of proficiency in both languages.

One of the limitations of our study is that we did not control for immigrant status and culture of the two language groups. Some authors (see Paap et al., 2015 for a review) have stressed the importance of controlling for these factors, since immigration status has been associated with higher intelligence, whereas differences in culture background may result in differences in the development of EFs. Although, we did not control for these factors, the participants in both language groups were from collectivist cultures only (Northern Greece and Albania; Eupedia, 2012). In addition, differences between the groups due to immigration status should have actually boosted the bilingual advantage effect, something that was not apparent in the present study.

To conclude our study does not support the hypothesis that learning two languages has a positive effect on cognitive development or performance. Although we did not manipulate the following factors, we can rely on the characteristics of our bilingual participants to suggest that neither L1/L2 similarity, nor language proficiency and training in switching between languages (as indicated by the SCA) seem to favour a bilingual advantage in interference control. Importantly, to our knowledge, there is only one study published on the bilingual advantage effect with Greek-Albanian bilinguals; based on the present data, and previous (Ladas et al., 2015), we can conclude that the bilingual advantage effect does not seem to be present in this sample of bilinguals.

Future investigations, using the same methodology, but involving different types of bilingual populations in the same study, could shed more light on whether the bilingual advantage effect is restricted to a very particular kind of bilingualism. One of the key differences between our study and previous studies that have employed the same or similar tasks, finding a positive effect however, is that we strictly controlled for SES and relied on a rather homogeneous sample of bilinguals (i.e. of low SES mostly, and speaking a specific pair of languages that share several similarities at the linguistic level). Given the recent suggestions for a publication bias influencing the magnitude of the suggested bilingualism advantage in cognition (see de Bruin, Treccani, & Della Sala, 2015), we hope that our study will contribute to disentangle the effects of context on the demonstration of language group differences, thus, informing the literature about the robustness and extent of the effect, as well as about whether the suggestions made so far, correctly reflect all research in the field (see Paap, Johnson, & Sawi, 2015). As Paap et al. (2015) note, a representative publication of findings regarding different populations and variables, seems even more important, if one considers both the inability to randomly assign the independent variable (i.e. language group), as well as the uncontrolled background variables in relevant studies (e.g. socioeconomic, immigration status, culture, etc.), which might have, however, affected cognitive performance (see also Paap, 2014; Paap & Liu, 2014).

Note

1. Although, we did not have a large number of trials, we conducted complementary analyses only with the first block of trials (three pairs of participants were not included in the analyses because accuracy was below 70%; $N = 84$) to rule out the possibility that the bilingual advantage disappeared with practice (Hilchey & Klein, 2011). As in the analyses conducted with all three experimental blocks, language group factor did not interact with cue or congruency. The trend for an overall slower response time in the bilingual group (613 ms), relative to the monolingual group (573 ms) was still present, yet not reaching statistical significance any more, $p = .089$.

Disclosure statement

No potential conflict of interest was reported by the authors.

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