International Journal of Bilingual Education and Bilingualism

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rbeb20

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To cite this article: Su Yeong Kim, Jinjin Yan, Wen Wen, Jiaxiu Song, Shanting Chen, Minyu Zhang, Belem G. Lopez, Maria M. Arredondo, Marci E. J. Gleason & Ka I. Ip (2024) Daily and ethnic discriminatory experiences and cognitive control in Mexican-origin bilingual language brokers, International Journal of Bilingual Education and Bilingualism, 27:7, 978-992, DOI: 10.1080/13670050.2024.2308663

To link to this article: https://doi.org/10.1080/13670050.2024.2308663

INTERNATIONAL JOURNAL OF BILINGUAL EDUCATION AND BILINGUALISM
2024, VOL. 27, NO. 7, 978–992
https://doi.org/10.1080/13670050.2024.2308663

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Daily and ethnic discriminatory experiences and cognitive control in Mexican-origin bilingual language brokers

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ABSTRACT

Few studies have considered bilingualism's impact on cognitive development within the sociolinguistic and cultural context of the immigrant communities where bilingualism is commonly practiced. In the United States, many Mexican-origin bilingual youth practice their bilingual skills by *brokering* (i.e. translating/interpreting between languages) for their immigrant parents who have low English proficiency. Meanwhile, these youth may also experience discrimination in their daily life. The present study focuses on Mexican-origin bilingual youth brokers ($N = 334$) in order to examine how discriminatory experiences (i.e. daily and ethnic discrimination) and bilingual brokering experiences captured by profiles are related to cognitive control performance (i.e. attentional control and inhibition). We found no significant direct influence of either bilingual broker profiles or discriminatory experiences on cognitive control. However, the associations between discriminatory experiences and cognitive control performance depended upon brokering experiences. Specifically, greater discrimination was associated with lower cognitive control performance among moderate brokers (with moderate bilingual experiences), but the association was attenuated among efficacious brokers (with positive bilingual experiences). Findings highlight the need to consider the sociolinguistic heterogeneity of both discriminatory experiences and language use when investigating cognitive control performance in bilinguals.

ARTICLE HISTORY
Received 26 September 2022
Accepted 8 January 2024

KEYWORDS
Bilingualism; Mexican-origin youth; language brokering; discrimination; cognitive control

Introduction

Spanish-speaking Latinx bilinguals are the largest bilingual group in the United States (Noe-Bustamante, Flores, and Shah 2019). While a plethora of studies on cognitive control have recognized the influence of linguistic processes in bilingualism (e.g. dual-language proficiency) (Bialystok, Craik, and Luk 2012; Gunnerud et al. 2020), the lived experiences of Latinx bilinguals are often neglected. In the United States, discriminatory experiences are especially rampant among Spanish-speaking Latinx bilinguals (Lopez, Gonzalez-barrera, and Krogstad 2018), and may function as a chronic stressor that impedes cognitive control performance (Gibbons et al. 2012). Given that 64% of the immigrant Latinx population reports not speaking English well (Noe-Bustamante and

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/13670050.2024.2308663.

Flores 2019), many Latinx Spanish-speaking children have the experience of translating or interpreting between languages for their immigrant parents with low English proficiency (i.e. language brokering) (Weisskirch 2017). Although the Adaptive Control Hypothesis (Green and Abutalebi 2013) suggests that different demands in the bilingual experience shape varied cognitive control abilities(Bialystok, Craik, and Luk 2012; Van Den Noort et al. 2019), this line of research is incomplete to the extent that it has not recognized language brokering in the sociolinguistic context of bilingualism (e.g. discrimination), which places demands that may shape the cognitive control abilities of language brokers.

Currently, studies on the influence of bilingualism and experiences of discrimination on cognitive control performance are two distinct lines of research, yet discrimination and brokering-related bilingual experiences often co-occur in the daily life of Latinx-origin youth (Kim et al. 2018). Youth may experience discriminatory treatment, such as getting treated with less respect or courtesy because they are speaking Spanish in a predominantly English-speaking environment. To elucidate how sociolinguistic background may influence cognitive control ability, the current study investigates the direct and interacting influences of discriminatory experiences and bilingual broker profiles on cognitive control in a sample of Mexican-origin youth, who represent the largest Latinx-origin subgroup in the U.S. (Noe-Bustamante, Flores, and Shah 2019). The current study focuses on the experiences of youth who function as language brokers for their mothers, given that youth in immigrant families translate most often for mothers (Orellana, Dorner, and Pulido 2003) and language brokering for mothers thus reflects a common sociolinguistic context of bilingualism for Mexican-origin youth.

Discriminatory experiences and cognitive control performance

Cognitive control refers to the mechanisms supporting the management of cognitive resources to conduct goal-directed activities (Mackie, Van Dam, and Fan 2013). Stressful life experiences may invoke chronic stress responses and impair cognitive control performance (Mueller et al. 2010). A unique and important chronic stress for children in immigrant families is discrimination, which, according to the integrative model for ethnic minority children, has a detrimental influence on child development across multiple domains, including cognitive development (García Coll et al. 1996). In light of the current hostile socio-political climate in the U.S. for Latinx immigrants, a more thorough understanding of discrimination and its impact on the cognitive control abilities of Mexican-origin youth is needed (Ayón and García 2019).

Discrimination refers to the experience of being treated with less courtesy or respect, or getting harassed and insulted (Williams et al. 1997). Daily discriminatory experiences may be attributed to multiple social identities that intersect, or to a non-specific source (Kessler, Mickelson, and Williams 1999), such as socioeconomic status, immigrant status, gender, or skin color. Such discriminatory experiences may have a profound influence on adolescent development, as they spread across different aspects of daily life with relatively high frequency among youth (Schmitt et al. 2014). In fact, the Pew Research Center reported that in the past year, 62% of Latinx youth experienced at least some type of discrimination in their daily life (Noe-Bustamante et al. 2021).

Ethnic discrimination is a specific form of daily discrimination that can be attributed to one's ethnic minority status. Given the uncontrollable nature of ethnic discriminatory experiences, they may be particularly detrimental to brain functioning related to cognitive control (Datta and Arnsten 2019). Although both daily and ethnic discrimination are threats and salient psychosocial stressors for adolescents, they each have their own unique characteristics (i.e. daily discrimination: higher frequency and spread across different life aspects) (Schmitt et al. 2014); ethnic discrimination: uncontrollable (Datta and Arnsten 2019). Thus, it is important to consider both types separately in the same study to understand their influence on cognitive development in ethnic minority youth, However, most previous studies have tended to focus on either daily or ethnic discrimination and thus are unable to reveal the different roles played by daily and ethnic discrimination within the

same sample. Despite the critical role of discriminatory experiences in ethnic minority children's lives (García Coll et al. 1996), the link between discrimination and cognitive control performance in youth has been relatively understudied.

Most studies on this topic have focused on adults or the aging population and yielded mixed findings. Zahodne et al. (2020) found that among aging adults, higher daily discrimination was associated with lower cognitive control scores extracted from a confirmatory factor analysis based on 23 tasks measuring five cognitive domains. A previous study focusing on Mexican-origin adults, of whom 86% were born in Mexico, also showed that experiencing more ethnic discrimination was detrimental to cognitive functioning (Muñoz, Robins, and Sutin 2022). However, a recent study shows no direct association between lifetime racial discrimination and inhibition among a sample ranging in age from 18 to 85 (Keating et al. 2021). Given that adolescence is a time in which individuals are highly susceptible to environmental stress (Gee and Casey 2015), utilizing an adolescent sample to distinguish between daily and ethnic discriminatory experiences is needed to understand better the associations between different forms of discrimination and cognitive control. In addition, the mixed findings in previous research may be due to studies not distinguishing between inhibition and attentional control, or failing to distinguish inhibition and attentional control from other cognitive control/function abilities, instead treating cognitive function or control as a singular construct. Moreover, previous studies mainly relied on self-reported survey measures (e.g. 'You stick with what you are doing until you have finished with it') to assess cognitive control performance (e.g.Gibbons et al. 2012), and are thus limited by participants' subjective bias and their differing introspective abilities. To fill these gaps in the literature, the current study utilizes a dataset from a sample of Mexican-origin youth to investigate how discriminatory experiences are related to cognitive control performance, as measured by a behavioral task (the Simon task). The Simon task (Simon and Rudell 1967) measures two cognitive control abilities: attentional control, the ability to concentrate one's attention on task-relevant information; and inhibition, the ability to suppress the prepotent response for task-irrelevant information (Bialystok, Craik, and Luk 2012; Ridderinkhof et al. 2004).

Bilingual brokering experience and cognitive control performance

The Adaptive Control Hypothesis (Green and Abutalebi 2013) suggests that individuals adapt to the demands of bilingual practices and contexts, as evidenced by changes in their cognitive control abilities, speaking to the need to consider the heterogeneity of bilingual experiences that exact different demands. Previous studies have shown that variations in bilingual experiences may be related to different levels of cognitive control performance (Takahesu Tabori, Mech, and Atagi 2018; Van Den Noort et al. 2019). One common bilingual practice in immigrant communities is language brokering. Translating and interpreting between two languages in one conversation during language brokering is one example of bilingual language use in the dual-language context, as described in the Adaptive Control Hypothesis (Green and Abutalebi 2013). The demands placed on brokers in the dual-language context may enhance their ability to maintain attention on one goal (i.e. attentional control in the current study) and the competence to suppress the interference of irrelevant information (i.e. inhibitory control) (Kroll and Bialystok 2013; López 2020). Moreover, varied experiences in language brokering may place different demands and have varied influence on adolescents' cognitive control abilities (Rainey, Davidson, and Li-Grining 2016); however, few studies have considered such variations among language brokers.

According to the tripartite framework of language use (Kim et al. 2020), variations in language brokering experiences in immigrant communities can be captured by three components: dual-language proficiency, language brokering frequency, and subjective feelings about language brokering (e.g. positive and negative feelings related to brokering, and whether brokering is central to their sense of identity). In terms of dual-language proficiency, Rosselli et al. (2016) showed that bilinguals with high dual-language proficiency outperform those with low proficiency in both languages

during a verbal inhibition task. One possible reason is that with high language proficiency, two languages may be more easily activated automatically, requiring greater cognitive control performance to inhibit the influence of one language over the other. One important way to develop high dual-language proficiency is through language usage (Taie 2014).

Frequent language brokering experiences provide opportunities for youth to practice cognitive control, and the influence of brokering on cognitive control may also depend on how language brokering experiences are appraised. For example, youth who are disengaged in brokering may have fewer brokering experiences, and thus they may lack the opportunity and motivation to enhance their cognitive control performance through brokering (López et al. 2021). On the other hand, youth who have more positive experiences and fewer negative experiences while brokering may be more willing to engage and invest cognitive effort while brokering, and thus have more opportunities to practice and enhance their cognitive control performance (Weisskirch 2013; Windsor and Anstey 2008).

Kim et al. (2020) applied the tripartite framework of language use to language brokering in immigrant communities and identified four subgroups of adolescent language brokers. Specifically, Kim et al. (2020) conducted latent profile analysis to group 604 Mexican-origin bilingual broker youth based on 11 indicators capturing their brokering experiences in three arenas (i.e. Spanish and English proficiency, brokering frequency, and subjective feelings about brokering). This study showed that about half of Mexican-origin bilingual broker youth (i.e. the *moderate* group) had average scores on dual-language proficiency, brokering frequency, and positive feelings about brokering, as well as low levels of negative brokering feelings. About one-fourth of youth (i.e. the *efficacious* group) engaged in brokering with high dual-language proficiency, high brokering frequency, a strong sense of brokering centrality (i.e. sense of how important brokering is to their identity), more positive feelings about brokering, and similar negative feelings about brokering compared to the *moderate* group. Some youth (i.e. the *ambivalent* group) engaged in relatively frequent brokering with average scores on positive feelings towards brokering but strong negative feelings towards brokering. A small but significant group of youth (i.e. the *nonchalant* group) were less involved in brokering, with a weak sense of brokering centrality and fewer positive and negative brokering feelings. Kim et al. (2020) revealed that the *efficacious* group displayed the best academic outcomes one year later. The largest group, the *moderate* group, showed levels of academic performance that were similar to those of the *ambivalent* and *nonchalant* groups. The varying levels of academic achievement among youth with different bilingual-broker profiles may reflect differences in cognitive control performance, given that better cognitive control is associated with improved academic outcomes (Visu-Petra et al. 2011).

At least one study illustrates the need to consider subjective brokering experiences along with dual-language proficiency (López et al. 2021). Specifically, the study investigated how the association between first and second language proficiency and cognitive control performance may vary across youth with different levels of negative brokering emotions. It showed that negative brokering emotions can be a significant factor influencing cognitive control performance only for those with low first language (rather than second language) proficiency, supporting the notion that the first language, which is developed in early life, may be more emotionally relevant. The potential associations between different aspects of the bilingual experience and cognitive control performance suggest it is necessary to consider the joint influences of language proficiency, brokering frequency, and subjective brokering experiences (i.e. bilingual broker profiles) on cognitive control performance simultaneously.

The joint influence of discriminatory and bilingual brokering experiences on cognitive control performance

The Adaptive Control Hypothesis suggests that cognitive control abilities are developed to adapt to the demands of language use contexts (Green and Abutalebi 2013). A growing body of research has also considered how language use contexts (i.e. monolingual, bilingual) may contribute to cognitive

control performance differently when individuals are in varied socioeconomic contexts, such as when they are under different levels of economic stress (Engel De Abreu et al. 2012; Hartanto, Toh, and Yang 2019). Engel De Abreu et al. (2012) found that bilingual children from low-income families outperform monolinguals in cognitive control. Similarly, Hartanto, Toh, and Yang (2019) found that being bilingual can attenuate the adverse influence of low household income and maternal education level on inhibition ability, suggesting that bilingual experience may serve as a buffer against the effects of ecological stress (e.g. socioeconomic disadvantages). However, to our knowledge, few studies have examined how one's report of perceived discrimination may interact with bilingual experiences to influence cognitive control performance, despite discriminatory experiences being an important sociocultural context factor that can impact youth development in immigrant families (García Coll et al. 1996; Lopez, Gonzalez-barrera, and Krogstad 2018). Therefore, in order to build upon and to extend the Adaptive Control Hypothesis (Green and Abutalebi 2013), it is essential to consider sociocultural contexts (e.g. language brokering experiences in the context of discriminatory experiences) in Mexican-origin bilingual youth, as such contexts may influence the demands placed on cognitive control abilities.

The co-occurrence of brokering and discriminatory experiences in everyday life among adolescent brokers speaks to the importance of considering both experiences simultaneously when investigating their influence on cognitive control performance. The demands that brokering places on cognitive control abilities may differ across various discriminatory experiences. In other words, discriminatory and brokering experiences may jointly influence cognitive control abilities. For example, *efficacious* brokers may be more likely to actively practice brokering and engage in positive bilingual experiences even in the context of their discriminatory experiences, when compared to *moderate* brokers who engage in brokering as a mundane bilingual experience. If so, *efficacious* brokers (relative to *moderate* brokers) may be better equipped with the ability to handle demands placed by their brokering experiences on cognitive control performance, and may thus be more likely to adapt to the demands of discriminatory experiences. That is, while *moderate* brokers may exhibit lower levels of cognitive control performance when they experience more discrimination (Zahodne et al. 2020), this association may be attenuated among *efficacious* brokers. Given that little is known about the heterogeneity in the associations between discrimination and cognitive control performance among different types of brokers, the current study aims to explore such variations by using a person-centered approach to represent the heterogeneity in brokering profiles.

Present study

The current study recognizes the lived experience of Latinx adolescent bilinguals by investigating the impact of discriminatory experiences and bilingual broker profiles on cognitive control. The study utilizes a sample of Mexican-origin bilinguals, the largest Latinx ethnic group in the U.S. (Noe-Bustamante, Flores, and Shah 2019), and conducts multilevel modeling to account for multiple trials in the Simon task as a way of assessing cognitive control. The Simon task was selected because the current study's goal is to examine the sociolinguistic effect on cognitive control of a non-verbal task. Unlike the Flanker task, which may introduce a ceiling effect (in both accuracy and reaction time; Anokhin et al. 2022), and the Stroop task, which typically requires participants to view or listen to word stimuli (Epp et al. 2012) and thus could confound results related to bilingual experience, the Simon task is age-appropriate and does not require retrieval of lexicon knowledge. There are three study aims (Figure S1): (1) examine the influence of discriminatory experiences (i.e. daily discrimination and ethnic discrimination) on cognitive control performance (i.e. attentional control and inhibition; Path A); (2) examine the relation of bilingual broker profiles to cognitive control performance (Path B); and (3) explore the interactive influences of discriminatory experiences and bilingual broker profiles on cognitive control performance (Path C). We made three hypotheses corresponding to the three aims. First, higher levels of daily and ethnic discrimination experiences would be associated with lower levels of cognitive control performance (i.e. attentional control

and inhibition). Second, based on the characteristics of each profile and results from Kim et al. (2020) suggesting that *efficacious* (relative to *moderate*) brokers showed better academic outcomes, we hypothesized that the *efficacious* group would outperform the other three groups in terms of their cognitive control performance. Third, language brokering would attenuate or accentuate the influence of discrimination on cognitive control performance, depending on variations in language brokering experiences (i.e. *efficacious* versus *moderate* groups). Due to the lack of research evidence, we did not make a specific hypothesis about whether the type of discrimination (i.e. daily discrimination or ethnic discrimination) or the type of cognitive control (i.e. attentional control or inhibition) may have differential effects.

Methods

Participants

The data were collected between 2017 and 2020, drawn from a project that targeted English-Spanish bilingual youth who functioned as language brokers in their Mexican immigrant families. There were 334 Mexican-origin youth ($age_{range} = 14.99$ to 21.22; $M_{age} = 17.62$, $SD = 1.05$). About half of the sample identified as female (56.6%, $n = 189$) and the rest as male (43.4%, $n = 145$). Most of the sample was born in the United States (76.3%, $n = 255$), and the rest in Mexico (23.7%, $n = 79$). The mean and median household income was between $30,001 to $40,000, and the median parental education level was middle school.

Procedure

The target families were recruited via public records, school presentations, and community recruitment in central Texas. Families in which the parents were of Mexican origin, with a child who translated for at least one parent, qualified for participation. Parents provided informed consent, and youth provided consent/assent before study participation. Bilingual interviewers administered the survey questionnaires by reading questions aloud to participants and recording participants' responses on a laptop computer. Adolescent participants performed the Simon task individually on a laptop (Dell Latitude 3480, 14 Inch) after research assistants read the instructions aloud to them.

Materials

Language brokering experience

Youth bilingual broker profiles were identified with assessments in the following three areas (Kim et al. 2020): dual-language proficiency (i.e. Spanish and English proficiency), bilingual practice frequency (i.e. language brokering frequency for mothers), and subjective feelings about bilingual practice (e.g. positive and negative feelings when translating for mothers, and whether the practice is central to their sense of identity).

Daily discrimination

Youth responded to nine items from the Everyday Discrimination Scale (Williams et al. 1997) to assess their perception of daily discrimination experiences. Using a four-point Likert scale ranging from 1 (*never*) to 4 (*frequently*), youth rated how often each of the discrimination experiences occurred on a daily basis ($\alpha = .87$).

Ethnic discrimination

Youth responded to nine items from the Everyday Discrimination Scale (Williams et al. 1997) with the addition of 'because I am Mexican' in the sentence to assess their discrimination experiences due to

being of Mexican heritage. On a four-point Likert scale ranging from 1 (*never*) to 4 (*frequently*), youth rated how often each of the ethnic discrimination experiences happened to them ($\alpha = .91$).

Attentional control and inhibition

Attentional control and inhibition were assessed using the Simon Task, which measures cognitive control via stimulus-response reactions (Bialystok et al. 2004; Simon and Rudell 1967). Each participant was administered 32 randomized ordered trials (16 congruent trials and 16 incongruent trials). Congruent trials measure attentional control ability while incongruent trials measure inhibition ability. At the beginning of each trial, an 800-ms fixation cross (+) was presented at the center of the screen (x = 6 in., y = 3.38 in.) followed by a 250-ms blank interval. Then, a 1,000-ms stimulus appeared on the left (x = 3 in., y = 3.38 in.) or right (x = 9 in., y = 3.38 in.) side of the screen. Next, participants were asked to respond to the different colored squares (e.g. red square or blue square) presented on the screen as quickly and as accurately as possible. During congruent trials, the red/blue stimulus was presented on the same side as the corresponding keyboard key. During the incongruent trials, the stimuli were presented on the opposite side of the computer screen, but response keys remained the same. After each response was made, a 250-ms blank interval was displayed.

Covariates

Youth demographic variables (age; gender) and nativity were included as covariates.

Results

Cognitive control performance across bilingual broker profiles and discriminatory experiences

The results of multilevel moderation models assessing the main effects and the interactions of daily/ethnic discrimination and language brokering profiles on cognitive control performance are presented in Table 1, Models 1 to 4. Models 1 and 2 depict the effects of *daily* discrimination while Models 3 and 4 depict effects of *ethnic* discrimination on attentional control (i.e. congruent trials reaction time) and inhibition (i.e. incongruent trials reaction time) modeled separately. The within-person model revealed that the mean value of congruent trials reaction time is 387.24 ms, while the mean value of the reaction time in incongruent trials is 425.90 ms. Upon adding the between-person effects, no significant main effects were observed for youth bilingual brokering profiles or discriminatory experiences across models (See Tables S4–S7), indicating that neither perception of bilingual brokering experiences nor discriminatory experiences directly influence adolescents' cognitive control performance (i.e. attentional control or inhibition).

The interplay between bilingual broker profiles and discriminatory experiences on cognitive control performance

Attentional control (i.e. Congruent trials)

For *daily discrimination*, the results showed significant interaction effects between bilingual brokering profiles and daily discrimination, specifically among youth in the *efficacious* versus *moderate* group ($b_{eff\ vs\ mod} = -53.05$, $p < .001$, Model 1) and between the *nonchalant* versus *moderate* group ($b_{non\ vs\ mod} = -34.48$, $p = .04$, Model 1). To further probe for the significant interaction effects, simple slope analyses were conducted between these groups. As shown in Figure S3a, in the context of experiencing higher (relative to lower) levels of daily discrimination, youth in the *moderate* group had longer reaction times in congruent trials (i.e. worse attentional control) ($b_{mod} = 20.79$, $p = .02$), whereas youth in the *efficacious* group had shorter reaction times in congruent trials (i.e. better attentional control) ($b_{eff} = -32.26$, $p = .04$). Youth in the *nonchalant* group did not show a significant increase or decrease in congruent trials reaction time in the context of daily discrimination ($b_{non} = -13.69$, $p = .34$).

Table 1. Multilevel model assessing the interactions of participants' bilingual broker profiles for mother, daily/ethnic discrimination on congruent/incongruent trials response time.

Daily discrimination	Model 1 (AIC = 62999.20)			Model 2 (AIC = 57352.90)		
	Outcome: congruent trials RT			Outcome: incongruent trials RT		
Predictor	*b*	*SE*	*p*	*b*	*SE*	*p*
Level 1 – Within-individual						
Intercept	500.77	53.91	**<.001**	529.63	54.82	**<.001**
Level 2 – Between-individual						
Nonchalant	0.09	8.42	0.99	−7.31	8.57	0.39
Efficacious	3.81	9.19	0.68	5.53	9.35	0.55
Ambivalent	−11.55	11.51	0.32	−14.87	11.69	0.20
Daily Discrim	20.79	9.16	**0.02**	28.66	9.32	**<.001**
Daily Discrim x Nonchalant	−34.48	17	**0.04**	−36.24	17.28	**0.04**
Daily Discrim x Efficacious	−53.05	17.81	**<.001**	−55.17	18.23	**<.001**
Daily Discrim x Ambivalent	−6.32	22.06	0.77	−5.34	22.48	0.81
Age	−5.54	3.01	0.07	−4.95	3.07	0.11
Gender	−37.94	6.45	**<.001**	−35.18	6.56	**<.001**
Nativity	1.53	7.49	0.84	1.03	7.62	0.89
Ethnic discrimination	Model 3 (AIC = 63004.89)			Model 4 (AIC = 57355.40)		
	Outcome: congruent trials RT			Outcome: incongruent trials RT		
Predictor	*b*	*SE*	*p*	*b*	*SE*	*p*
Level 1 – Within-individual						
Intercept	501.86	54.56	**<.001**	535.70	55.17	**<.001**
Level 2 – Between-individual						
Nonchalant	0.11	8.62	0.99	−6.90	8.72	0.43
Efficacious	5.66	9.32	0.54	7.60	9.44	0.42
Ambivalent	−11.65	11.34	0.31	−15.91	11.44	0.17
Ethnic Discrim	10.11	9.07	0.27	21.84	9.17	**0.02**
Ethnic Discrim x Nonchalant	−19.58	17.77	0.27	−23.09	17.96	0.20
Ethnic Discrim x Efficacious	−32.51	15.25	**0.03**	−44.78	15.57	**<.001**
Ethnic Discrim x Ambivalent	6.7	19.63	0.73	8.33	19.83	0.67
Age	−5.61	3.05	0.07	−5.33	3.09	0.09
Gender	−38.63	6.5	**<.001**	−35.66	6.58	**<.001**
Nativity	1.77	7.59	0.82	1.77	7.67	0.82

Note: Discrim = discrimination. Daily/ethnic discrimination is grand-mean centered. Reference group = Moderate. RT = Reaction time. AIC = Akaike information criterion. Gender: 1 = boy, 0 = girl; Nativity: 1 = U.S.-born, 0 = Mexico-born. Estimate of Daily/ethnic discrimination in Model 4 indicates the simple slope effect of daily/ethnic discrimination on congruent trials Reaction Time for the Moderate group as the reference group. We rotated the reference group in Model 4 to examine the significance of the simple slope for each bilingual broker group.

For *ethnic discrimination*, similar patterns of a significant interaction effect between bilingual brokering profiles and ethnic discrimination on reaction time in congruent trials were observed among youth in the *efficacious* versus *moderate groups* ($b_{eff\ vs\ mod} = -32.51$, $p = .03$; Model 3). To further probe for the significant interaction effects, simple slope analyses were conducted between the two groups. As shown in Figure S3b, in the context of experiencing higher levels of ethnic discrimination, youth in the *efficacious* group showed a marginally significant shorter reaction time in congruent trials ($b_{eff} = -22.40$, $p = .07$), but youth in the *moderate* group did not show a significant increase or decrease in congruent trials reaction time ($b_{mod} = 10.11$, $p = .27$).

Inhibition (i.e. Incongruent trials)

For *daily discrimination*, the results revealed a significant interaction effect between bilingual brokering profiles and daily discrimination among the *efficacious* versus *moderate* group ($b_{eff\ vs\ mod} = -55.17$, $p < .001$) and among *nonchalant* versus *moderate* group ($b_{non\ vs\ mod} = -36.24$, $p = .04$; Model 2). To further probe for the significant interaction effects, simple slope analyses were performed between these groups. As shown in Figure 1a, the simple slope analysis showed that in the context of higher (relative to lower) daily discrimination, youth in the *moderate* group reported longer reaction times in *incongruent* trials (i.e. worse inhibition) ($b_{mod} = 28.66$, $p < .001$), whereas

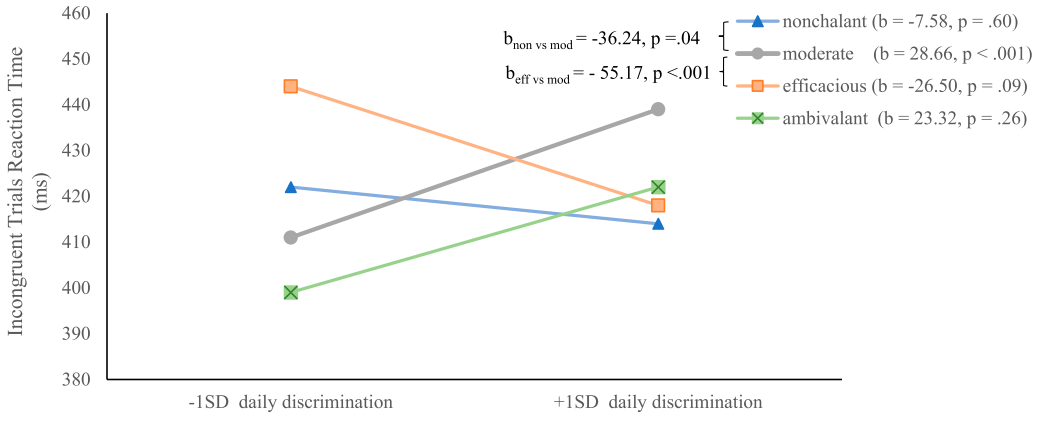

Figure 1a. Two-way interaction between daily discrimination and bilingual profiles when translating for mothers in predicting incongruent trials reaction time.

youth in the *efficacious* group had marginally significant shorter reaction times in incongruent trials (i.e. better inhibition) ($b_{eff} = -26.50$, $p = .09$). The *nonchalant* group did not show a significant increase or decrease in incongruent trials reaction time ($b_{non} = -7.58$, $p = .60$).

For *ethnic discrimination*, a similar pattern emerged, such that there was a significant interaction effect between bilingual brokering profiles and ethnic discrimination on reaction time in incongruent trials among the *efficacious* versus *moderate* group ($b_{eff\ vs\ mod} = -44.78$, $p < .001$; Model 4). To further explore the significant interaction effects, simple slope analysis was conducted between the two groups. As presented in Figure 1b, in the context of experiencing higher levels of ethnic discrimination, youth in the *moderate* group showed longer reaction times in incongruent trials (i.e. worse inhibition) ($b_{mod} = 21.84$, $p = .02$), whereas youth in the *efficacious* group showed a marginally significant shorter reaction time in incongruent trials ($b_{eff} = -22.94$, $p = .07$) (i.e. better inhibition).

Discussion

The results revealed no overall effect of discriminatory experiences on cognitive control performance (including both attentional control and inhibition) among Mexican-origin youth in immigrant families, nor were there differences in cognitive control among the different bilingual broker

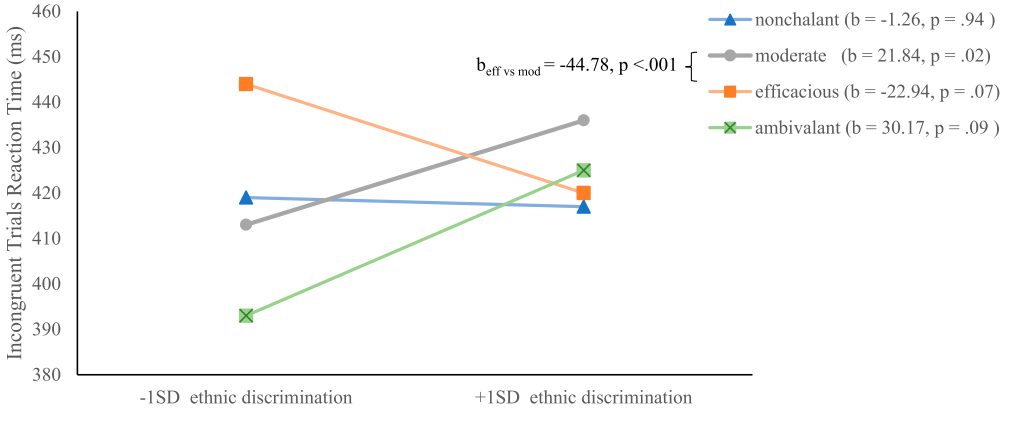

Figure 1b. Two-way interaction between ethnic discrimination and bilingual profiles when translating for mothers in predicting incongruent trials reaction time.

profiles (i.e. *efficacious*, *moderate*, *ambivalent* and *nonchalant*). However, we found that adolescents' brokering experience moderated the associations between discriminatory experiences and their cognitive control performance (see below for a detailed description). Our study revealed preliminary evidence that cognitive control ability among Mexican-origin bilingual youth is jointly influenced by discriminatory and language brokering experiences, emphasizing the importance of capturing the sociolinguistic context and lived experiences of Latinx bilinguals, who have been relatively neglected in the field of bilingualism.

Joint effects of discrimination and bilingual experiences on cognitive control

Despite discriminatory experiences being especially rampant among Spanish-speaking individuals in the U.S. (Lopez, Gonzalez-barrera, and Krogstad 2018), prior studies on the inverse association between discrimination and cognitive control performance were based on mostly monolingual participants, such as African Americans, and/or did not systematically assess bilingual proficiency or experiences (Gibbons et al. 2012; Zahodne et al. 2020). Addressing this gap, our study revealed that discrimination was associated with cognitive control, *but* the nature of the association depended upon differential language brokering experiences.

Specifically, in the context of experiencing higher (relative to lower) levels of daily discrimination, youth in the *moderate* language brokering group (a majority group in our sample, characterized by low to moderate levels of language proficiency, translation frequency and subjective brokering experiences) had lower cognitive control performance, as indicated by slower reaction time during congruent and incongruent trials of the Simon task. However, the association between daily discrimination and cognitive control performance was different among the *nonchalant* and *efficacious* groups compared to the *moderate* group. While such an association was not found among *nonchalant* brokers, *efficacious* brokers (with higher dual-language proficiency, greater brokering frequency and positive subjective brokering experiences) exhibited *better* attention control (faster reaction time during congruent trials) and a trend-like pattern of better inhibition (faster reaction time during incongruent trials) in the context of higher discriminatory experiences, suggesting a potential facilitating effect. A similar pattern also emerged when examining the interactive effect of *ethnic* discrimination and brokering profiles on cognitive control performance, highlighting the generalizability of the findings to different types of discriminatory experiences – a salient psychosocial threat (Adam et al. 2020) that may signal or trigger the need for cognitive control (see below).

Plausible mechanisms based on the adaptive control hypothesis

It is beyond the scope of our study to examine specific language brokering components (language proficiency, brokering frequency, subjective experiences of brokering experiences) that may facilitate better cognitive control, and the exact mechanism is still unclear. A plausible mechanism is that higher engagement in language brokering activities may provide a naturalistic dual-language context (i.e. opportunities to speak both languages in the same environment and switch languages between sentences during conversation, i.e. inter-sentential switching (Green and Abutalebi 2013; Lai and O'Brien 2020)), allowing bilingual youth to practice their attentional control and inhibition skills, especially for those in a situational context of higher discrimination that requires greater cognitive control.

According to the Adaptive Control Hypothesis (Green and Abutalebi 2013; Green and Wei 2014), a dual-language context would enhance cognitive control compared to a single language context, given the greater potential for inference and the need to control for it. Relative to other language brokering profiles, youth in the *efficacious* group reported the highest engagement in language brokering (i.e. high translation frequency, brokering centrality and positive experiences), which may reflect a higher degree of engagement in a dual-language context through more frequent and/or higher intensity inter-sentential switching with their parent in their day-to-day life. Positive language brokering experiences and higher language proficiency may further reinforce brokering frequency and inter-sentential switching, creating a positive feedback loop of higher engagement in the

dual-language context for *efficacious* brokers. This higher engagement in turn may 'train' *efficacious* brokers to perform better in nonverbal measures of cognitive control (Lai and O'Brien 2020), compared to those with less engagement (e.g. *moderate* brokers).

We did not find direct support for the Adaptive Control Hypothesis, as there was no direct effect of language brokering experience on the cognitive control skills measured in our study, which is consistent with a prior study showing that subjective reports of engagement in the dual-language context did not predict non-verbal cognitive control performance (Lai and O'Brien 2020). Rather, we found that *efficacious* brokers performed better in cognitive control when they reported higher (relative to lower) levels of discrimination.

Given that experiencing discrimination is cognitively taxing and poses a salient threat to youth (Adam et al. 2020), it may provide a situational context or contextual cue signaling the need to recruit more cognitive control as a coping response. That is, for *efficacious* brokers with higher engagement in the dual-language context, more experiences of discrimination that require more frequent recruitment of cognitive control may in turn facilitate better cognitive control performance (relative to those outside this situational context), given that these discriminatory experiences provide a situational context in which efficacious brokers can practice cognitive control skills under demanding circumstances. This plausible hypothesis awaits further investigation, especially studies using objective measures of dual-language engagement, such as coding of inter-sentential switching during naturalistic language brokering observation (e.g. Lai and O'Brien 2020). Our findings highlight the importance of simultaneously considering different interactive contexts (e.g. language brokering experiences in the context of discriminatory experiences) among Mexican-origin bilinguals that may influence the demands on cognitive control abilities.

Other possible explanations

It is also possible that for *efficacious* brokers, having better attentional control (and possibly inhibition) in a context of higher discrimination may be a context-specific adaptation (Ellis et al. 2017), as they are able to practice attention and inhibition during language brokering processes while under stress, which is reflected in their subjective positive brokering experiences. In contrast, *moderate* brokers with fewer positive brokering experiences may exhibit lower attentional control and inhibition when they experience discrimination, given that they may have fewer opportunities to adapt their performance under the influence of discrimination. Alternatively, low to moderate levels of language brokering competencies and experiences may reduce the opportunity for family assistance or other cultural assets (e.g. strong sense of ethnic identity) that can attenuate the stressful experiences of discrimination (Corona et al. 2012; Telzer and Fuligni 2009), making *moderate* brokers more vulnerable to the adverse effects of discrimination. Future studies that examine whether language brokers are better able than non-brokers to perform cognitive tasks under stress using an experimental design may help to elucidate the exact mechanism underlying our findings.

It is important to note that the association between discrimination and cognitive control also differed between the *nonchalant* and *moderate* groups. Relative to the *moderate* group, for which higher discrimination was associated with lower cognitive control performance (as indexed by reaction time in congruent and incongruent trials), we found no association between discrimination and cognitive control skills among *nonchalant* brokers (a group characterized by the lowest levels of language brokering engagement, competencies, and experiences). One possible explanation is that *nonchalant* brokers may be less sensitive to emotionally challenging situations (e.g. discrimination) given that they are 'emotionally disengaged' from brokering, and thus their cognitive control is not impacted by discrimination. While it is beyond the scope of our study, future studies could benefit by examining potential mediators (e.g. contextual sensitivity, negative affect to discrimination) that may explain the null associations between discrimination and cognitive control among *nonchalan*t brokers.

Nevertheless, our findings are in line with existing literature suggesting that bilingual experiences may buffer against the effects of chronic stressors (e.g. economic stress) on cognitive control performance (Engel De Abreu et al. 2012; Hartanto, Toh, and Yang 2019), and the broader literature suggesting

that providing family assistance (such as by language brokering) may attenuate the negative effect of stressors among Mexican-origin youth (Corona et al. 2012; Telzer and Fuligni 2009). In our study, we expand prior literature to suggest that language brokering experiences (as seen in the *efficacious* brokering profile) may attenuate the negative influence of discrimination among Latinx youth.

Conclusion

Our findings highlight the importance of capturing the sociolinguistic context and lived experiences of Latinx bilinguals to understand the interplay between bilingualism and discrimination, and the ways in which this interplay affects youth cognitive development. Our findings also empirically support the adapting cultural systems framework (White, Nair, and Bradley 2018), which posits that language brokering, as an important aspect of children's socialization, interacts with contextual stressors (e.g. discrimination) to influence youth development. We suggest that positive language brokering experiences (as seen in the *efficacious* broker profile) are beneficial for adolescent brokers' cognitive development by protecting them from the detrimental effects of discrimination. This finding has implications for developing intervention strategies that foster positive brokering engagement, which is usually omitted in the bilingual literature.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

Support for this research was provided through awards to Su Yeong Kim from (1) National Science Foundation, Division of Behavioral and Cognitive Sciences, 1651128 and 0956123, (2) National Institute on Minority Health and Health Disparities 1R21MD012706-01A1 and 3R21MD-012706-02S1, (3) Eunice Kennedy Shriver National Institute of Child Health and Human Development 5R03HD060045-02, (4) Russell Sage Foundation, 2699 (5) Spencer Foundation, 10023427 (6) Hogg Foundation for Mental Health JRG-102, (7) Office of the Vice President for Research and Creative Grant and Special Research Grant from the University of Texas at Austin, (8) College of Natural Sciences Catalyst Grant from the University of Texas at Austin, and (9) Eunice Kennedy Shriver National Institute of Child Health and Human Development 5P2CHD042849-20 grant awarded to the Population Research Center at The University of Texas at Austin. These funding sources had no role other than financial support. Dr. López contributed to this article in her personal capacity. The views expressed are her own and do not necessarily represent the views of the National Institutes of Health or the United States government. Correspondence concerning this article should be sent to Wen Wen.

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