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Research Paper

The Relationship Between Bilingualism and Control Aspect of Intelligence: A Study of Persian-speaking Individuals

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ABSTRACT

Introduction: The study of the relationship between bilingualism and the possible impact it might have on the control aspect of intelligence of adults in general and preschool children, in particular, has always been the subject of controversy for researchers. This research, following the related findings and gaps in the literature and inspired by Craik and Bialystok's (2005) framework, tries to divulge whether bilingualism could be related to the control aspect of intelligence. As our secondary goal, we also tried to see whether there are correlations between different tests assessing control.

Methods: In this descriptive correlational study, via the convenience sampling method, we selected our participants. Methods: In doing so, 10 age-gender-matched Mazandarani-speaking monolinguals and the same matched bilinguals have been selected. Moreover, the literacy and socioeconomic status of subjects have been controlled. The tests for assessing subjects' executive control included day-night Stroop, the dimensional change card sort (DCCS), test of variables of attention (TOVA), and the computerized attention network test (ANT). Our participants' performance in language proficiency task as well as control tasks was demonstrated. Furthermore, via the conduction of the Pearson correlation statistics, the relationships between the participants' performance in diverse control tasks and language task were investigated.

Results: The results showed that bilinguals outperform monolinguals in all control tests except DCCS.

Conclusion: Bilingualism could provide children with an executive control advantage promoting them in tasks demanding thought and action control.

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Highlights

- Language proficiency is not necessarily related to an advanced attentional control.
- Mazandarani-speaking monolinguals and bilinguals perform equally in the "knowledge" domain of intelligence.
- Bilinguals' performance in the control task of intelligence was better than their monolingual counterparts.
- It was corroborated that intelligence is not a homogeneous psychological construct.
- Generally, in tasks requiring suppression, bilinguals outperform monolinguals.

Plain Language Summary

The investigation of the relationship between control aspect of intelligence and the statue of monolingualism or bilingualism has always been the subject of controversy. "Control" aspect signifies the ability of an individual to suppress the provoking stimuli, that is, to ignore the external stimuli in favor of an intended linguistic or non-linguistic element. Our major objective in this research was to compare the performance of Mazandarani-speaking bilinguals and monolinguals in diverse control as well as vocabulary assessment tasks. Specifically, we wanted to see whether bilingual children could perform better than monolingual children in tasks requiring the inhibition capability. Furthermore, we attempted to investigate whether there were correlations between different control assessment tasks. Extending previous researches, we administered two additional cognitive tasks, namely, test of variables of attention (TOVA) and day and night task to evaluate our participants' control capability. In linguistic (vocabulary) proficiency assessment task, Peabody picture vocabulary task (PPVT), we did not find bilinguals' advantage over monolinguals. In contrast, bilinguals outperformed their monolingual counterparts in all other control tasks except dimensional change card sort (DCCS). Meanwhile, strong correlations between most control tasks were observed. The results corroborated that bilingual children outperformed their monolingual counterparts in tasks demanding strong thought and action control. Also, the conduction of most control tasks might be more challenging for monolinguals, and bilingual children, thanks to their linguistic statutes, could ignore irrelevant response or stimuli more easily, and perform better in the majority of cognitive control demanding tasks.

1. Introduction

Bilingualism is a linguistic phenomenon which can be studied both within sociolinguistic and psycholinguistic perspectives. Within the light of sociolinguistics, in which this term was initially introduced and defined, it is defined as a distinctive linguistic ability of individuals by which they are capable of communicating with each other using two different linguistic varieties (Wardhaugh, 2011). Two types of bilingualism have been introduced in the literature. In simultaneous bilingualism, an individual could speak two languages easily, thanks to being born in a bilingual parents' setting. On the other hand, in sequential bilingualism, an individual, initially being able to speak one language, after a certain period of time, would learn another language via the social setting he lives (Holmes & Wilson, 2017). The study of the relationship between bilingualism and intelligence has always attracted scientists. The common ground of all these researches is that they follow an ability-based stance on intelligence. In this regard, they define intelligence as the ability of a person to solve a problem, adapt to a new situation, reason, and critically think about a subject proposing different types of intelligence including naturalistic, linguistic, kinesthetic, special, and interpersonal among other things (Slavin et al., 2009)

There have been lots of research which tried to investigate the impact of bilingualism on adults as well as children's intelligence (Ardila & Ramos, 2010; Bialystok, 2001, 2005; Lambert & Anisfeld, 1969; Peal & Lambert, 1962). Even though, in some research, the relationship between bilingualism and intelligence has been proven (Bialystok, 2005; Bialystok et al., 2006; Lambert & Anisfeld, 1969; Lee Salvatierra & Rosselli, 2011), there have still been other researches emphasizing lack of relationship between subjects' performance in tests assessing intelligence even in some circumstances, holding an extremely negative stance concluding that

bilingualism leads to confusion and retardation (Appel & Muysken, 2005; Grosjean, 1982; Mclaughlin, 1978; Sampath, 2005).

Hence, this controversy in the literature on the possible effect of bilingualism on subjects' intelligence has still remained unanswered. There have been some gaps in the literature that might have affected the results. First of all, the distinction between adults' and children's different performances and the major impact that the demographic variable of age might have on subjects' performance have been disregarded (Yang & Lust, 2004; Zelazo & Frye, 1997; Zelazo et al., 2003). Secondly, even if the classification of subjects regarding different age groups (adults vs. children) has been taken into consideration, strict within-group classification has not yet been envisaged carefully (Yang & Lust, 2004). In fact, it has been scientifically proven that bilingual children aged 4 perform much better than 3-year-old children thanks to their advanced cognitive development. In other words, as children age, their cognitive capabilities would automatically develop enabling them to perform very well in tests assessing the control component of intelligence mainly due to the enrichment of the executive system whose mechanism is controlled by the dorsolateral prefrontal cortex (Barbey et al., 2013).

Thirdly, in these researches as Bialystok correctly asserted (Bialystok, 2001), intelligence has been taken as a homogeneous category as if all its subcomponents would have the same function. So, following such a perspective would distort the result questioning the reliability of the conclusion. In other words, researchers like Craik and Bialystok (2005), wisely drawing an important distinction between knowledge and control, have claimed that the latter which is concerned with processes of learning, knowledge manipulation, decision-making, ambiguities, unknown, challenges, and more importantly adaptability, would play a dramatic role in subjects' differentiation.

Fourthly, treating groups of children and adults as the same, some researchers have used the same tests to assess individuals' performance in intelligence assessment tests (Yang & Lust, 2004). So, in our view, heterogeneity as an important parameter should be taken into account to reconcile the results.

Noteworthy to mention, typological differences of languages acquired by bilingual children and the probable different impact that it might have on the intellectual abilities of subjects have also been neglected in these researches. That is, considering major lexico-semantic as well as syntactic structures between Indo-European and non-indo-European languages, we might predict subjects' different performance in these two dramatically different types of languages (Chang et al., 2008).

Last but not least, another sociolinguistic important factor possibly affecting the result is the extent to which both vernacular and second language has been used in different social settings like home, daycare, friendly settings, and so on (Sternberg & Grigorenko, 1997). In other words, unlike other studies, we have not considered bilingualism as a homogeneous concept, considering its variations. The more a second language is used in a diverse social setting, the better we might predict bilinguals perform intelligence assessment tests, probably due to their dexterity in easy code-

switching. This finding has been ratified in different languages (Hakuta & Diaz, 2014; Rosselli et al., 2016).

Having considered all these aforementioned gaps in the literature, this research aims at reconciling the existing controversy in the literature by comparing the performance of 10 strictly matched 4-year-old Persian- speaking monolinguals and the same matched Persian-Mazandarani bilinguals in control assessment tests. Adopting a processed-based view of intelligence, we made a distinction between two major components of intelligence namely control and knowledge. In this regard, we scrutinized the control component of intelligence as it has already been attested that it is this component that would distinguish and differentiate individuals from each other (Benedek et al., 2014). According to Craik and Bialystok (2005), part of the existing controversy in the literature might be due to taking an ability-based stance leading to the distortion of the results. Thus, according to Bialystok (2001), the necessity of constant inhibition of one language would lead to processing advantages. So, in this situation, we are not dealing with the non-active language being completely switched off, rather we are confronting the process of attenuating or suppressing the non-active language similar to what is observed in selective attention theory (Treisman, 1964). This practice of inhibition, as Bialystok et al. Asserted, might place bilinguals in a higher position than monolinguals regarding general cognitive processing (Bialystok et al., 2005). Thus, following all these theoretical observations, and as our primary objective, we are going to see whether acquiring another language by preschool children could have a contributing impact on their cognitive control development. To achieve this objective and taking a very strict and narrow stance on the phenomenon of simultaneous bilingualism via selecting those preschool children who have acquired both languages at home, not

at any elementary educational system, we could better compare the performance of bilinguals in control assessment tests with that of monolinguals. Furthermore, adopting Yang and Lust's (2004) methodology but utilizing two additional assessment tools to measure subjects' control aspect of intelligence, we are going to see whether these different tasks would measure the same parameter. Should it not be the case, the importance of methodological differences in designating the relationship between the control aspect of intelligence and bilingualism could be highlighted.

2. Materials and Methods

Participants

This study conforms with the World Medical Association Declaration of Helsinki. Utilizing the convenience sampling method, we selected our participants. Initially, 20 age- gender-matched preschool monolinguals and the same number of matched Persian- Mazandarani bilinguals were selected. The average age of these children was 54 months old (4; 6). Concerning bilinguals, it should be mentioned that all belonged to those simultaneous bilinguals who had acquired these two languages either from bilingual mothers and fathers or from parents speaking different languages. Moreover, the literacy and socio-economic status of subjects has been controlled. A total of 10 monolingual girls, 6 bilingual boys, and 4 bilingual girls were excluded from the analyses of the tests due to literacy control, i.e. they had more advanced literacy (n=1), failure to complete the tests (n=14), or experimental errors (n=5). Furthermore, since in former studies, it has been attested that lack of interest might be an intervening parameter affecting subjects' performance, only highly motivated subjects who were eager to participate in the study were selected (Messick, 1989, 1995, 1999). Ultimately, 10 monolinguals and 10 bilinguals completed the tests and were included in the final analyses.

Procedures

The tests for assessing subjects' cognitive control aspect of intelligence included the day-night Stroop, the dimensional change card sort (DCCS), a Computerized attention network test (ANT), and the test of variables of attention (TOVA). Translating and adapting all these tests in Persian, their high reliability and validity were attested. To achieve face and content validity, all tests were sent to 10 neuropsychologists and speech-language therapists. After amending the items according to the experts' opinions, they were sent to the five of those experts who had already responded well at the first stage. The analysis showed that there were some items in the tests requiring revision due to cultural differences between Western countries and Iran. Ultimately, despite making lots of attempts to modify the items as little as possible, some of them were modified to accommodate Iranian culture. It is noteworthy to mention that all subjects' performances in the tests were scored by the researcher and a trained autonomous judge to ensure inter-rater reliability. The analysis indicated point-to-point agreement ranged from 92% to 100% (Mean=96%). In the next stage, sitting in a very quiet room to take part in DCCS, and a (ANT, a TOVA, all Persian monolinguals and bilinguals were met by bilingual researchers. To control socioeconomic parameters, all participants were selected from a similar middle-class neighborhood in Amol, Mazandaran province. The language spoken by the residents of this city was Mazandarani, the northern category of Iranian languages. Furthermore, to control children's literacy, questionnaires as well as direct observations of children's linguistic behaviors with their parents' consent were used. Meanwhile, as Yang and Lust (2004) noted, due to the impact of literacy on executive attention, no subject had satisfactorily developed writing as well as reading skills. Moreover, all monolingual and bilingual children had intact auditory as well as visual abilities.

Also, to measure subjects' vocabulary knowledge for both Persian monolinguals and Persian-Mazandarani bilinguals, we performed PPVT (Dunn & Dunn, 1997) in Persian for both groups. In this test, as a measure of receptive vocabulary, subjects were presented with a list of pictures and they are asked to point to the one corresponding to the word read by the researcher. The time needed to conduct the test would be 15 minutes. Moreover, 5 additional minutes were allocated for scoring and interpreting the results. A "basal" is considered provided that the child recognized all consecutive pictures. Meanwhile, if the child incorrectly recognized six of the continuous items, a "ceiling" was established.

In the DCCS task (Zelazo et al., 2003), all children, were confronted with a series of bivalent test cards annexed to the wall of containers (red square and blue circle) and 10 testing cards different from the target card in one dimension, were required to sort test cards. This sorting action should initially be conducted by one dimension (color) and then according to the other (shape). This test could provide a very useful index indicating children's executive function development (Zelazo, 2006).

In the ANT task (Yang et al., 2011), initially, stimuli were presented visually to the subjects on a laptop computer. Then, they were told to respond to two input keys

matching the direction of swimming hungry fish feeding them. The task was composed of 3 conditions. A single fish (neutral condition) or a row of five animated fish (congruent or incongruent condition) swimming in the left or right direction to the central fish that the participant should respond to and the remaining fish were considered as flankers. The condition in which the five fish were swimming in the same direction was defined as a congruent one and if the middle one's swimming direction was different from the rest, we were dealing with an incongruent one. As Mezzacappa (2004) asserted these three flanker types and four warning cue types (double cue, spatial cue, no cue central cue) are proven to be very effective tools for evaluating different forms of attention including alerting attention, orienting attention, and executive attention. Meanwhile, the efficiency of executive attention was achieved via subtraction of reaction time in congruent types from incongruent ones in different cue types. Reaction time in milliseconds was envisaged as a measure to evaluate attention network efficiency.

To verify the bilingual status of the children, we conducted the Virtual Linguistic Lab's Children Multilingualism Questionnaire (Blume & Lust, 2012) based on which parents of the children were required to complete a questionnaire composed of six parts: The linguistic background of the family, the degree of code-switching by children, some informative data about the child, her writing as well as reading capability, summary and comments. The Persian version of the VLL children's multilingualism was translated by two linguistically advanced Farsi-Mazandarani bilinguals, and the necessary adaptations concerning the selection of the best equivalents were made. A major advantage of this questionnaire is that it was composed of open-ended questions making all measures complementary concerning achieving balanced information from Persian-Mazandarani bilinguals. The results of this questionnaire demonstrated that Persian-Mazandarani bilinguals, demonstrating properties of simultaneous bilingualism, speak both Mazandarani and Persian languages at home depending upon the appropriate situations. Outside the home, the same propensity was also observed.

First invented in the 1960s by Lawrence Greenberg, the test of variables of attention (TOVA) evaluates some important cognitive abilities including attention, processing speed as well as inhibition mechanism. An important advantage of this task making it suitable for young children is that it requires the least memory demand. Children's capability of paying attention is regarded as a pivotal executive function. Attention disorder is a significant characteristic of Attention Deficit Hyperactivity Disorder (ADHD). The child, having observed diverse letters flashing on a computer screen, is required to press the space bar as soon as she observes a specific letter. In the first part of the test, the child's impulsive behavior is recognized via his answers to a "non-target'. On the other hand, in the second section, the child's avoidance of prepotent answers is taken as his inhibition capability. Generally, it took 11 mins for the children to conduct the test (Greenberg & Waldmant, 1993; Leark et al., 2007). In this task, four measures including variability (how consistent children's responses were), reaction time (average reaction time), commission errors (impulsive responses), and omission errors (the number of missed items) were taken to evaluate children's performance.

And ultimately, as the most widely-used task to assess children's executive capability, the day and night task has to do with children's capability to hold two rules simultaneously in their mind while inhibiting and ignoring the prepotent one. Hence, it is predicted that in incongruent conditions, the

children's inhibitory mechanism could best be tested (Montgomery et al., 2008). The most important reason for choosing day and night task in this research and favoring it over the most widely used Stroop Color Task is that while the former doesn't need literacy on the part of the examinee, conducting the latter would require literacy. In this task, composed of 16 trials, the children were supposed to say the word "day" as soon as they observed a card on which a nighttime sky was shown. On the other hand, children are expected to say "night" when observing a picture of a "daylight" sky.

3. Results

Peabody picture vocabulary task (PPVT)

The results of PPVT highlighted no significant difference between bilinguals and monolinguals ($F_{(1, 25)}$=8.023, P=0.0005).

Day and night task

Following Simpson and Riggs (2005), errors were classified into two main categories including response set errors and semantic interference errors. According to these researchers, while response set errors deal with using the alternative response in the set rather than the target response, semantic interference errors happen when responding with pictures' names in the semantic competition rather than the already taught response. All errors in the task belonged to response set types (they tend

to say "night" for the night card and "day" for the day card) except for two semantic interference errors (they tend to say "darkness" instead of night). Bilingual children's performance on the day and night task (Mean±SD 10.42±4.36) was better than monolinguals (Mean±SD 6.42±3.36). To see whether the parameter "age" was related to subjects' performance in this task, we conducted a correlation analysis indicating a lack of significant relationship between "age" and monolingual performance in the task ($r_{(17)}$=0.039, P=0.81). As for the bilingual group, the same result was observed ($r_{(16)}$=0.029, P=0 .79).

Test of variables of attention (TOVA)

The results of all indices of this task confirmed bilingual's advantage over monolinguals. That is, regarding omission errors, a significant advantage of bilinguals over monolinguals was shown (F=1.27, P<0.005). It shows that the number of targets they missed was less than those of monolinguals. Moreover, bilinguals outperform monolinguals in the index of variability demonstrating their responses were more consistent ($F_{(1, 16)}$=12.532, P=0.001). Also, in the commission error, the same inclination was observed indicating bilinguals' better performance than monolinguals ($F_{(1, 14)}$=11.522, P=0.005).

A computerized attention network test (ANT)

In this task, bilingual children outperformed monolinguals regarding accurate responses in all conditions ($F_{(1, 16)}$=12.532, P=0.001. So, our results, although consistent with Yang and Lust (2004), fail to replicate Bialystok's results (Bialystok, 1999). Moreover, the analysis of reaction times of correct responses in Persian monolinguals and Persian-Mazandarani bilinguals demonstrated that although the latter performed slightly better, no significant advantage was observed ($F_{(2, 16)}$=201.1, P=0.145). Computing network subtractions following the formulas and adapting Yang and Lust's (2004) framework, only positive values were taken; for monolinguals, 6 values for executive function attention, 5 values for orienting, and finally 9 values for alerting were considered; however, for bilinguals, 11 values for executive function, 7 values for orienting, and 8 values for alerting were considered. Utilizing a set of ANOVA on these three networks of efficiency scores, no significant impact of bilingualism was observed (P>0.214). Moreover, comparing the efficiency of networks and bilingualism, we did not observe any significant interaction ($F_{(1, 8)}$=1.762, P=0.976).

The dimensional change card sort (DCCS)

In DCCS, during the pre-switch phase, no error was observed and in the post-switch phase, both groups performed at ceiling level (n=8.6 for bilinguals and n=6.5 for monolinguals). Hence, this result replicates Yang and Lust's (2004) but fails to replicate Bialystok's (1999) result.

The relationships between different tasks

To understand whether different tasks for investigating executive attention are related, Pearson correlation analysis was conducted. Although in pro with Yang and Lust (2004), there was not any significant relationship between both monolinguals' performance in two tasks of ANT and DCCS (r=0.25, P=9.431) as well as bilinguals' performance in these two tasks (r=0.32, P=0.317), in other measures of executive assessment, the correlation results in these two groups were rather different. That is, while in the case of monolinguals, significant relationships were observed between day and night task and TOVA (r=0.41, P<0.05), day and night task and ANT (r=0.22, P<0.05), TOVA and ANT (r=0.28, P<0.005), no significant correlation was found between their performance in day and night task and DCCS (r=0.222, P=0.432) and also between TOVA and DCCS (r=0.111, P=0.341), in contrast, in bilinguals, the relationships between day and night task and TOVA (r=0.628, P=0.000) was significant. The same trends in other tasks including day and night task and ANT (r=0.608, P=0.005), day and night task and DCCS (r=0.413, P=0.000) as well as TOVA and ANT (r=0.623, P=0.005), TOVA and DCCS (r=0.533, P=0.005) were also observed indicating findings different from those reported in Yang and Lust (2004).

4. Discussion

Our primary aim in this research was the investigation of the relationship between the statutes of bilingualism and the control component of intelligence in 10 age-gender-matched Persian-speaking monolinguals and the same number of matched Persian-Mazandarani speaking bilinguals. In doing so, following Yang and Lust (2004), these two groups were subjected to different control assessment tasks. In addition to tasks employed by these researchers, we also utilized two different control assessment tasks, namely TOVA and day and night task. Hence, having participated in these tasks, the subjects' performance could have been compared. Moreover, we attempted to see whether performing different tasks of control by both groups could culminate in similar results. Concerning linguistic knowledge of Persian assessed by PPVT, unlike Bialystok (2015) results, we did not find

bilinguals' advantage over monolinguals. However, both groups' similar performance in the DCCS task corroborated the results similar to those observed by Yang & Lust (2004). Likewise, our results in ANT were similar to those observed by these researchers acknowledging positive relationships between early childhood bilingualism and the control component of intelligence. Meanwhile, the results of day and night tasks in the two groups were different demonstrating bilinguals' advantage over monolinguals in the accurate performance of this task. These findings are consistent with previous research (Bialystok & Senman, 2004; Carlson, 2005). As a matter of fact, the fact that children performed at near-ceiling level dismisses the possibility that the memory-demanding process of simultaneous maintenance of two rules might be regarded as the primary source of errors (Gerstadt et al., 1994). In another test of control assessment, TOVA, and bilinguals' advantage over monolinguals were also observed highlighting their better performance than monolinguals.

The results of day and night and TOVA corroborated Craik and Bialystok's (2005) theoretical framework, based on which although monolinguals and bilinguals are not different concerning the "knowledge" aspect of intelligence, in tasks assessing the inhibitory mechanism or "control", bilinguals'

superiority could be observed. So, as they concluded in their research, the findings of this research again show that in tasks demanding skillful manipulation of suppression, bilinguals outperform monolinguals. In this regard, considering intelligence as a homogeneous single psychological construct might no longer be logical. Meanwhile, monolingual and bilinguals approximately similar performance on the DCCS task on one hand, and bilinguals' advantage over monolinguals on day and night task acknowledges Carlson's 2005 claim that performing the former task causes much more difficulty for 4 years-old children because the task of sorting items according to their shapes and colors is not as strong as the task of finding an appropriate label for an already renown pictured item, ostensibly vivid in day and night task (Carlson, 2005). In this regard, Nigg's theoretical explanation is very illuminating. Making a distinction between "behavioral inhibition" and "interference control", he claims that while the former only requires the suppression of the prepotent response, the accurate performance in the latter involves not only suppressing behavior but also activating a conflicting response while constantly adhering to the rules to monitor your performance (Nigg, 2000). Moreover, children's errors on the task while responding to a card on which a distracted word is written could also be explained via the semantic competition hypothesis, proposed by Greenberg and Waldman, asserting that when a distracted item is activated through its depiction and is simultaneously associated with the target item, all these would enrich its salience to a level beyond young children's capability to get rid of its interference (Greenberg & Waldmant, 1993).

On the other hand, based on the results of this research and its practical implications, it could be concluded that bilingualism could provide children with an executive control advantage promoting them in tasks demanding thought and action control (Bialystok, 2001). In fact, in some cognitive studies (Bialystok, 1999) and even in neuropsychological studies (Posner & Fan, 2007), the crucial role of the "control" component of intelligence and the pivotal role it plays in selecting vital information has already been proven. Hence, enjoying this "control" advantage, bilinguals could perform much better than monolinguals in tasks requiring neglecting sometimes the labyrinth of irrelevant information and concentrating on the supposed target.

Furthermore, as the results of PPVT demonstrated, we did not find any advantage of linguistic knowledge in our bilinguals compared to monolinguals. As a result, our findings are inconsistent with those of other researchers. For example, Rosselli and his colleagues observed a high advantage of language proficiency in their young subjects' performance regardless of their status as monolinguals or bilinguals (Rosselli et al., 2016). Similarly, in another research, the advantage of high language

proficiency in preschool children was shown (Iluz-Cohen & Armon-Lotem, 2013). However, a caveat should be regarded concerning the results of these studies. That is, the results of the aforementioned research might have been different, had the sample been selected via a strict class of bilinguals. That is, in case bilinguals of simultaneous type had been selected like those recruited in our sample, or in a circumstance in which the child had utilized both two languages skillfully, these conclusions might have been different. Second, even if it was concluded that there was a possible relationship between the degree of language mastery and executive function capability, the nature of the task to assess executive performance might cast doubt on their results. As mentioned earlier, this gap in the results, as Nigg (2000) emphasized, might be since in some executive assessment tasks, only behavioral inhibition is employed which is much less demanding than tasks requiring an advanced level of interference control. Hence, in light of this theoretical stance, the observed discrepancy between the re-

sults of different control assessment tasks might also be better explained. The lack of correlation between these tasks could further bolster our interpretation. Again, had it been for the predominant role of language proficiency in subjects' performance, our recruited sample, if we had followed Yang and Lust's (2004) explanation, should have had a significant difference in performing the task. The aforementioned researchers claimed that the more advanced language mastery in monolinguals than bilinguals could be regarded as a compensatory mechanism enabling them to behave similarly in these two tasks; however, following these explanations, we should have predicted that our bilinguals would have performed much better than monolinguals, thanks to their linguistic skill as well as their probable executive function advantages, which was certainly not the case. So, at least the determining role of linguistic knowledge should be ruled out thoroughly. In our view, the nature of the task or method or methodological reason would play an outstanding role here.

Meanwhile, our findings also demonstrate that although the degree of language proficiency is related to conflict the resolution or the capacity of working memory, in tasks entailing goal maintenance and switching or generally in tasks requiring advanced attentional control, no such correlation could be observed (Tse & Altarriba, 2014).

Last, though by no means least, as it was mentioned in the literature, the discrepancy in this research and other research assessing executive attention, as Yang and Lust (2004) concluded, might be due to the unique syntactic and semantic structures of Persian as well as Mazandarani, the second encompassing some unique structures. Mazandarani and Persian to a lesser extent, are endowed with a floating syntactic structure. That is, it is possible to substitute syntactic

constituents without violating any grammatical constraints. Moreover, semantically, the way thematic roles are mapped onto syntactic categories are also different in these languages. Thus, in any future research, typological characteristics of languages should also be taken into consideration to account better for subjects' performance in the control assessment tasks.

5. Conclusion

The results of day and night and TOVA as control assessment tests demonstrated that bilinguals outperformed monolinguals in the aspect of inhibitory mechanism while both groups performed equally in the "knowledge" aspect of intelligence. Monolingual and bilingual Children's similar performance in DCCS and different behaviors in other tests of control assessment corroborated the hypothesis that control aspect of intelligence could not be envisaged as a homogeneous category as performing some suppression tasks might be easier than others. Henceforth, in order to conduct diverse cognitive control tasks, children might confront with different degrees of difficulty which could be more severe in bilingual children.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. Our research was was approved by the Research Ethics Committee of the University of Gonabad (Code: 2021/62202/3822/240).

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Conflict of interest

The author declared no conflict of interest.

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