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# Comparison of Social Cognition and Executive Functions of Motivation, Inhibitory Control, and Empathy in Bilingual and Monolingual Individuals

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Bilinguals demonstrate benefits in cognition (involving regulation of mental activity to resolve information) during processing. “Bilingual advance” is attributed to consistent management of two languages. Since bilinguals have a lifelong experience in controlling their two languages, they should have received more practice than monolinguals in processes engaging executive functions. In this study, an investigation was conducted on bilingual and monolingual students in Azarbaijan Shahid Madani University, East Azerbaijan province, Iran, in 2018. 100 students were selected using purposive sampling method. It is assumed that balanced bilinguals; those who are equally proficient in two languages experience a host of cognitive advantages rather than monolinguals. In this study, it was attempted to investigate if advantage of bilingualism extends to social cognition and executive function (i.e. motivation, inhibitory control, and empathy). For this purpose, Executive Function Index and Reading the Mind in the Eyes Test were

used in bilingual and monolingual individuals. Results showed that bilinguals possess better performance than monolinguals merely in social cognition ($t(98) = -4.37$, $p < .05$) and inhibitory control ($F(1, 98) = 10.95$, $p < .05$) but not in motivation and empathy.

***Keywords:*** bilingual, empathy, executive function, inhibitory control, motivation, social cognition.

Social cognition is one of the most important issues in interpersonal relationships with an important role in development of psychology (Kakojouybari, Shaghaghi & Baradaran, 2012). Social cognition involves capacities of individuals to process social information, that is, to perceive behavior of others and to react appropriately in social situations (Nijsse, Spikman, Visser-Meily, Kort & Heugten, 2019). Social cognition is known as the ability of brain to use, encrypt, and store information about others obtained over social interactions (Kinnon, Boyd, Frewen, Jetly, Richardson & Lanius, 2016). This involves perception, interpretation and processing social information (Glenthoj et al., 2016).

Theory of Mind (TOM) is one of the most important topics in social cognition and precondition to understand social environment and conflict in competitive social behavior (Kakojouybari et al., 2012). TOM is associated with mental states to understand something that people think about it such as ethics, lie, mistake, and deceit (Khanjani & Hadavandkhani, 2009). TOM competence is important for success in school because children's social skills are related to their academic achievement. Functions such as intelligence and language skills have been found to influence mind ability (Khosrorad & Soltanikohbanani, 2014). In cognitive science, Theory of Mind has been theoretically and empirically posited as a

central notion to a wide array of cognitive activities from language comprehension to moral reasoning (Jara-Ettinger, 2019).

TOM was first suggested by Premack and Woodruff in 1978. This hypothesis assumes that, whether monkeys can attribute their mental states to themselves and others to understand, explain, and predict the behavior. Since mental states are not directly observable and can be used to predict behaviors, it is possible to infer mental states, so-called TOM (Amin Yazdi, 2004). Evidence has shown that there is a strong connection between TOM and abilities of EF (Bradford, Jentzsch & Gomez, 2015).

Executive Function (EF) refers to a set of neurocognitive processes underlying goal-directed behaviors such as inhibition, working memory, self-regulation, planning, and organization (Zvara, Keim, Boone & Anderson, 2019). The term of EF is used to describe processes necessary to consciously control thoughts, emotions, and behavior. They have a central role in management of daily life of a person as well as providing individuals with right answer to environmental stimuli and ability to cope with the environment (SheykhNajdi, Mehri, Dolatshahi, Faghihzadeh & Kazemi, 2014). Psychologists are interested in EF because it is vital to explain Selfish behavior. For example, reduced EF due to a brain damage diminishes ability of an individual to live independently (Banich, 2009).

EF is a general term encompassing a number of activities that can be partly separated from one another. Experts in EF have described at least three distinct components of performance on executive tasks: inhibition, change, and update. These various aspects of EF have been discussed in bilinguals (Stocco, Ymasaki,

Natalenko & Part, 2012). EF includes the ability to organize and implement a specific kind of behavior. This is frequently measured by tests that assess planning, complex reasoning, tuning movement, and inhibition. These abilities are involved in almost all complex activities that humans engage in and are ubiquitously developed in neuro-developmental and neuropsychiatric conditions. In fact, failures in EF essentially lead to neurodevelopmental syndromes ranging from autism to learning disabilities (Medaglia et al., 2017).

Indeed, human cognitive processes are heavily dependent on linguistic abilities. However, it is still not clear that, whether the mind is shaped based on number of languages used by people. For many years, responses to this question emphasized negative consequences of bilingualism; even it has been warned that talking two languages can cause retardation in children. Surprisingly, radically different responses were offered by Peal and Lambert in1962, showing that bilingual francophone children in Montreal outperformed monolingual English-speaking children on a wide range of activities. Since then, modern era of bilingual research was born (Bialystok & Craik, 2010).

Bilingualism is considered as a global phenomenon and in many countries is referred to a norm for compatibility with the environment and effective factor in learning. Language development is rooted in structure of mind, emotions, and growth potential of children. Bilingualism as an objective and psychological fact has an important role in structuring the mind and breeding talented children. There are different approaches regarding definition of bilingualism. Among them, the most accepted definition was offered by Grosjean in 1992. In this definition,

bilingualism is referred to normal and everyday use of two languages (or more). Bilingual children are those who need to use two languages in their everyday life both at home and school. Bilingualism is even beyond the use of two languages. In other words, bilingualism is a variety involving high-level cognitive functions such as schema; creativity, awareness of meta-language, and flexibility in thinking is only associated with high bilingualism (Gholestanifard, Nikoghoftar & Shamssfandabad, 2016). Bilingual or multilingual individuals obtain more than one language simultaneously or successively and are thus required to exert fixed control over different grammar structures and vocabularies of more than one language and being capable of suitable switching or staying (Heim et al., 2019).

People who have developed bilingualism are typically more integrated in EF tests (Stocco et al., 2012).

Bilingual advantages in EF are thought to stem from managing two languages requiring administrative resources in a form of selecting required language and inhibiting the one which is not relevant to the situation. Since bilinguals have a lifelong experience in controlling their two languages, they should have received more practice than monolinguals in processes related to EFs. This idea is supported by previous studies showing earlier acquisition of second language, higher level of language skills in both languages, and balanced use of both languages may have positive effect on bilingual performance (Soveri, Rodriguoze–Fornells & Laine, 2011). Balanced bilinguals- individuals who are equally proficient in two languages- seem to experience a host of cognitive benefits rather than monolinguals. This so-called “bilingual advantage” is

obvious across lifespan: performance of young bilingual children requiring inhibition and focused attention on EF tasks is better than that of monolingual counterparts. In other words, healthy bilingual adults are faster than monolinguals on cognitive control tasks (Rhodes et al., 2016). This idea that bilingualism can significantly alter cognitive functioning is not new; what is new is that, this effect may be positive! One of the most important finding is related to bilingual advantage of cognitive processes and EF system responsible for attention control, distraction inhibition, and set change (Bialystok, 2010).

Also, EF is an important structure related to cognitive processes responsible for consciousness controlling, thinking, and action. Although, EF has been found to have a neuro-cognitive perspective but in recent years, its development has been a topic of interest to many scholars (Alizadeh, 2006). EF is a popular subject in contemporary research but has a various range of definitions (Zelazo, Muller, Frye & Marcovitch, 2003). The ambiguity has been resulted from the debate about whether EF is controlled by frontal lobe. Several researchers found that an individual with frontal lesions has limited functionality in EF test (Alvarez & Emory, 2006). Rodriguez, Santana & Exposito (2015) studied EF and language in children with different subgroups of language disorder. They revealed that children with linguistic disorder showed functional impairment, which was not limited to verbal activities, but was also observed in non-verbal activities, reflecting a global cognitive impairment along with reduction of linguistic and behavioral skills and showing complexity regarding profile of this disorder.

EF serves to monitor and control thoughts and actions and includes skills such as self-regulation, inhibitory control, planning, attention flexibility, error correction, and detection, resistance to interference, and working memory. Benefits of EF are increasingly believed to be linked with TOM development during preschool course (Carlson, Moses & Claxton., 2004). Moll, Snowling, Gobel & Hulme (2015) believed that two important foundations for learning are language and executive skills. They studied language and executive skills in number and arithmetic skills in children at family-risk of dyslexia and typically developing control. The same cognitive processes have been found to account for variability in arithmetic skills in both groups. Early development of language and executive skills predicated variations in preschool verbal number skills, which in turns, predicted arithmetic skills in school. In contrast, phonological awareness did not predict later math skills. These results showed that verbal and executive processes develop basic verbal number skills influencing development of formal arithmetic skills.

Over time, bilingualism has attracted researchers' attention to its effect on cognitive development and intelligence capabilities (Fayyazi, Sahragard, Rowshan, Zandi, 2014). Studying relationship between language and thinking has always been a topic of interest for many researches in different fields. In recent years, theorists have greatly emphasized on peer review language acquisition and development of concepts (Yaagubnejhad & Hasanzadeh, 2015). Study on cognitive consequences of bilingualism has a long history and goes back to $20^{th}$ century. Since bilingualism is an important phenomenon in the world, it is assumed that being raised in two-

language environment can influence on brain development (Pirhani, Kianersi, Nasiripoor & KhaliliPaji, 2015).

Studies conducted after the 1960s, especially in the past 30 years indicated cognitive benefits of bilingualism (Fayyazi et al, 2014). Since 1960s, the researchers have shown positive effect of bilingualism. In Iran, half of people speak in two languages, but limited researches have been carried out on this issue. So in this study, the following hypotheses are put forth. First, according to the effect of bilingualism on cognitive abilities, it was assumed that bilingual individuals are superior to monolingual individuals in terms of social cognition. Second, based on the studies on language role in EF, it was assumed that bilingual individuals had better performance in EFs (i.e. motivation, inhibitory control, and empathy) and they had more capabilities compared to monolingual individuals in this field.

## Method

Since it is recommended to use at least 30 people per each group in a comparative research (Delavar, 2015), in this study, 50 people per each group were enrolled. Participants included healthy bilingual adults; fluent in Azari and Persian (N=50; 7 males; 43 females) as well as healthy monolingual adults speaking Persian (N=50; 4 males; 46 females) recruited from Azarbaijan Shahid Madani University in Tabriz, Iran. Bilinguals either had learned both languages at home or learned them since their childhood whereas monolinguals had learned only one language until adolescence or adulthood. Most participants had received formal instruction for learning foreign languages (such as English or French) but were not

functionally fluent in languages other than Azari or Persian. In this research, purposive sampling method was used. To this end, bilingual (Azari-Persian) and monolingual (Persian) students were selected from Azarbaijan Shahid Madani University and after coordination with the authorities of Azarbaijan Shahid Madani University and obtaining the license, questionnaires (Reading the Mind in the Eyes Test and EFs Index) were distributed among bilingual (Azari-Persian) and monolingual (Persian) students. Participants were informed about objectives of the research and discretion regarding participation in the research, and were ensured of confidentiality of their information. Then, an informed consent was obtained from all of them.

**Instrument**

**Reading the Mind in the Eyes Test (RMET)**

This is a neuropsychology test, which is related to reading the mind, and developed in 2001 by Baron–Cohen et al. This test includes images of the eye-region of the face of different actors relative to 36 different modes. For each picture, 4 words are provided to describe mental states. In any image, respondents should choose an option that best describes mental state of the person in the image only through visual information using 4 options. Maximum score gained following selection of right words in this test is equal to 36 and minimum one is equal to 0. In Iran, a study reported that Alpha coefficient of this test is equal to 72%, and retest reliability coefficient in a sample of 30 students within 2 weeks was found to be 61% (Zabihzadeh, Nejati, Maleki, Darvishilord & Radfar, 2012).

**EFs index (EFI)**

EF Index (EFI), designed and developed by Spinella in 2001 is a self-report questionnaire to assess EF. In Iran, this test was translated by Ahmadi, Bafandeh, and Dadashi (2017) and its reliability was reported to be appropriate. Alpha coefficient of this test is equal to 82%. This test is well correlated with other EF tests. This is a comprehensive tool to assess EF in non-clinical population. This test is short and easy grading and is appropriate to run on larger sample. This test consists of 5 subtests including 1- motivation, 2- organization, 3- strategic planning, 4- inhibitory control, and 5- empathy. Some items in this test represent worse EF grading of which is reverse. Items that have grading include 2, 4, 5, 6, 11, 12, 13, 15, 17, 20, 22, 23, and 24. Items related to motivation are 1, 4, 7, and 14, those related to organization are 2, 6, 17, 22, and 23, for inhibitory control, they are 5, 11, 15, 20, and 24, for empathy, they are 8, 12, 16, 18, 21, and 25, and also items related to strategic planning are 3, 9, 10, 13, 19, 26, and 27.

## Results

The present study sample included 50 bilinguals and 50 monolingual students. Descriptive data obtained from analysis of EF index is presented in Table 1.

**Table 1**

**Mean and Standard Deviation of EF Components and Social Cognition in the Groups**

| Variable | Group | Mean | Standard deviation | Sample |
|---|---|---|---|---|
| Motivation | Monolingual | 15.64 | 2.33 | 50 |
| | bilingual | 15.08 | 1.83 | 50 |
| Inhibitory Control | Monolingual | 18.88 | 2.67 | 50 |
| | bilingual | 20.52 | 2.26 | 50 |
| Empathy | Monolingual | 21.26 | 3.56 | 50 |
| | bilingual | 21.38 | 3.07 | 50 |
| Social Cognition | Monolingual | 20.10 | 3.43 | 50 |
| | bilingual | 22.82 | 2.74 | 50 |

As shown in Table 1, mean and standard deviation of motivation in monolingual group is equal to 15.64 and 2.33, respectively, and in bilingual group, it is equal to 15.08 and 1.83, respectively. Mean and standard deviation of inhibitory control in monolingual group is equal to 18.88 and 2.67, respectively, and in bilingual group, it is equal to 20.52 and 2.26, respectively. Mean and standard deviation of empathy in monolingual group is equal to 21.26 and 3.56, respectively and in bilingual group, it is equal to 21.38 and 3.07, respectively. Mean and standard deviation of social cognition in monolingual group is equal to 20.10 and 3.43, respectively and in bilingual group, it is equal to 22.82 and 2.74, respectively.

To measure normal distribution of data, Shapiro-Wilk test was used. Obtaining a significant alpha level in this test ($p>.05$) represents violation of normality (Meyers, Galen &Garino, 2016). Result showed that, alpha level of Shapiro-Wilk test is not statistically significant.

**Social Cognition**

Independent Samples T-test was used to evaluate social cognition scores in monolingual and bilingual individuals. To check default equality variance of social cognition in two groups, Leven's test was used. Results showed a value of $p>.05$ indicating that mean variance of the study is equal to the results obtained from equality variance assumption. Results obtained from Independent Samples T-test are reported in Table 2.

**Table 2**
**Results Obtained from Independent Samples T-test between Two Groups in Social Cognition Vriable**

| Groups | Sample | Mean | Mean difference | Std.Error differenc | df | t | sig |
|---|---|---|---|---|---|---|---|
| Monolingual | 50 | 20.10 | -2.72 | .62 | 98 | -4.37 | .001 |
| bilingual | 50 | 22.82 | | | | | |

Using T-test means of social cognition scores were compared monolinguals and bilinguals. Based on results obtained from this comparison, it can be concluded that difference between two groups is statistically significant ($p<.05$ and $t(98) = -4.37$). According to this, bilinguals with mean of 22.82 are superior to monolinguals with mean of 20.10 in social cognition variable.

**Executive Function (Motivation, Inhibitory Control, and Empathy)**

To study EF (motivation, inhibitory control, and empathy), scores of multivariate test (MANOVA) were used for both monolinguals and bilinguals. M. Box test was not statistically significant for equality covariance (M. Box= 9.59, sig= .51, $p>.05$) suggesting that covariance matrix of dependent variable is equal for independent variable levels (language).

To review correlation between variables, Bartlett's test was used. Results of Bartlett's test showed a statistical significance level (Approx. chi-square= 49.87, sig=.00 and $p<.001$) representing that there is enough correlation between dependent variables to continue this analysis. To determine a significant effect of language on EF (motivation, inhibitory control, and

empathy) Wilks' Lambda test was used. Results are reported in Table 3.

**Table 3**
**Results Obtained from Multivariate Tests between Two Groups in EF**

| Valu | Test | F | Hypothesis df | Error df | sig | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Pilla's Trace | .21 | 7.66 | 4 | 95 | .00 | .24 |
| Wilks 'Lambda | .75 | 7.66 | 4 | 95 | .00 | .24 |

Results obtained from this test showed that there is a significant difference between two groups at least in one of EF components (motivation, inhibitory control, and empathy) ($F= (95, 4) = 7.66$ and $sig=.00$ and $p<.01$).

To determine default equality variance of EF components in groups (monolingual and bilingual individuals) Leven's test was used. Results showed that variance of EF components is equal in both groups and is not significantly different ($p>.05$), indicating reliability of data for the next results. According to the results, analysis of between -subject effect was done and results are presented in Table 4.

**Table 4**

**Results Obtained from Tests Conducted on between -Subject Effects**

| Source | Dependent variable | Type III Sum of squares | df | Mean square | F | sig |
|---|---|---|---|---|---|---|
| Bilingual/ Monolingual | Motivation | 7.84 | 1 | 7.84 | 1.77 | .18 |
| | Inhibitory Control | 67.24 | 1 | 67.24 | 10.95 | .001 |
| | Empathy | .36 | 1 | .36 | .03 | .85 |

As illustrated in Table 4, there is a significant difference in inhibitory control between two groups of monolinguals and bilinguals ($F(1, 98) = 10.95$ and sig=.001 and $p<.05$). However, there was no significant difference in motivation ($F(1, 98) = 1.77$ and sig=.18 and $p>.05$) and empathy ($F(1, 98) = .03$ and sig=.85 and $p>.05$) between both groups. Study on EF variables in both groups confirmed that language effect is significant on inhibitory control, but does not have significant effect on motivation and empathy.

## Discussion

### Bilingual Effect on Social Cognition

Results of this research showed that there is a significant difference in social cognition between bilingual and monolingual individuals. These findings are in consistence with results presented in the studies by Pirhani et al. (2015), Cox et al. (2016) and Yaagoubnejhad et al. (2015). They showed that there is a significant difference between cognitive functions and linguistic abilities in bilingual and monolingual children. In addition, performance of bilingual children in these functions is better than that of monolingual children.

It has been reported that language switch is associated with activity of posterior and lateral cortex. A study showed a conflict between Broca's area and left frontal area in relation to language switch task. In general, FMRI studies about language switch in bilinguals proposed a distributed activity in cerebral cortex converged in forehead areas. Brain is responsible for language switch, which is also very important regarding public attention and cognitive control. Overlap between active brain areas in language switch and cognitive control suggests that there may be a possible conflicting similar mechanism in both activities and this process may help to explain superior performance of bilinguals in doing non-verbal conflicting assignments (Azimi, 2012). Social cognition involves cognitive processes of understanding, interpretation, and processing social information (Glenthoj et al., 2016). Therefore, social cognition means how individuals think about thoughts, feelings, motivation, and behavior of themselves as well as others (Mashhadi, 2003). Previously, dominant attitude about bilingualism and its effect on knowledge and intelligence was negative mainly due to the fact that bilingualism causes problems such as pressure on brain, barrier to learn the language of the society, identity crisis, mental confusion, inability in effective thinking, and even schizophrenia. Owing to these issues, a common advice to parents was preventing development of bilingualism in children. But recently, the researchers have found that bilingualism has benefits especially in cognitive issues. For example, Studies indicated that there is a positive relationship between bilingualism and cognitive skills in performing non-verbal tasks (Arbabi, Sharifi & Mashhadi, 2014).

**Bilingual Effect on EF (Motivation, Inhibitory Control, and Empathy)**

Results of analysis on executive function variables showed that there is a significant difference in some EF components between two groups of bilingual and monolingual individuals. In other words, there was a significant difference in inhibitory control between both groups. However, there was no significant difference in motivation and empathy variables between these groups, meaning that ability of inhibitory control in bilinguals is better than monolinguals. Several studies compared bilingual and monolingual individuals, and findings concluded that bilingualism has benefits in relation to EF especially on the ability to control inappropriate information (inhibitory control).Since, bilinguals have a lifelong experience in controlling their two languages, and they should have received more practice than monolinguals in processes engaging executive performance. This idea is supported by previous studies showing that earlier second language (L2) acquisition enhances levels of language proficiency in both languages and creates a more balanced use of both languages that may have positive effects on executive performance in bilinguals. Further, researchers showed that bilingual advantage in EF might be related to the degree to which a bilingual individual uses two languages in conversations in everyday life. Bilinguals who tend to combine the languages throughout the day might have received more practice in monitoring processes. This includes selection of required language, which in turn shows a better executive performance of bilinguals coming from diglottic sociolinguistic environments, where the languages are held separate. Although, these considerations may highlight the need to relate specific aspects of everyday bilingual behavior to

performance on executive test measures. Exact mechanisms underlying bilingual executive advantage are still not clear. Researchers suggested that bilingual advantage in inhibition tasks might be attributed to the fact that bilinguals are able to control the language when it is not required at a given moment. Moreover, they are more efficient in processing of a combination of different types of trails. This is associated with the fact that bilinguals constantly need to keep track of two languages in order to select appropriate language for the situation (Soveri al, 2011). Researchers demonstrated inhibitory control model of bilingual language processing according which, it is assumed that a basic inhibitory control mechanism plays a significant role in bilingual language use by suppressing words that are not currently in use. For example, bilinguals might inhibit words from their native language when speaking their second language. Based on this model, bilingualism could empower domain-general inhibitory control with extensive practice and bilinguals could then use their improved control in performing non-verbal tasks (Rhodes et al, 2016).

Previous research has shown a strong relationship between executive ability including inhibitory control and verbal ability in initial development (Morasch & Bell, 2011). Inhibitory control and working memory are two executive skills assumed to be at the heart of relation between EF and TOM. Successful social cognition requires both the ability to hold multiple perspectives in mind (i.e., working memory) and the ability to suppress irrelevant perspectives (i.e., inhibitory control). Individual differences in inhibition and working memory have been found to be correlated with each other and both are significantly related to TOM tasks (Carlson et al., 2004). Evidence suggests that bilingual children outperformed their

monolingual peers on meta-linguistic tasks requiring EF, which led to the assumption that there might be a general EF advantage from bilingualism in nonverbal processing as well, as supported by numerous studies. Studies support the idea that, infants raised in bilingual homes were significantly more successful in learning new response than those exposed to only one language, indicating that the basis for EF differences is established in the first few months of life (Calvo & Bialystok, 2014).

The present research can be considered a ground for more attention to modify language teaching. According to the effect of bilingualism on social cognition and executive function, tasks of parents and educational authorities would become doubled regarding language learning. Therefore, the present study can attract managers' attention to importance of language learning and usage of appropriate methods in language learning.

It should be noted that, herein, the study population included only the students. In addition, only bilinguals speaking Azari-Persian were enrolled, which limits generalization of results of this research. To address this, it is suggested to recruit the participants with different age, academic background, and language abilities for further studies.

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