Article

Examining the Association Between Executive Functions and Developmental Domains of Low-Income Children in the United States and Turkey

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Abstract

This study examined the relations between executive functions and developmental domains of preschool children from low-income families through an intercultural perspective in the U.S. and Turkey. A total of 471 children and their primary caregivers participated in the Turkey part of the study, while 286 children and their parents engaged in U.S. sample. Regression analyses revealed that fine motor,

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problem solving, and executive functions of children between two contexts were significantly different from each other. In the U.S., executive functions predicted communication, problem solving, and fine motor development, whereas in the Turkish sample, executive functions did not predict domain scores. Child gender predicted four of five developmental outcomes in the U.S., whereas maternal education predicted two of five outcomes in Turkey. In addition, invariance testing demonstrated that predictors to outcomes were not significantly different between the two countries. Country differences from the first set of outcomes were explained in the context of the research sites, children's socialization, and cultural expectations surrounding child development. This study raises questions about relations between executive functions and developmental domains for future research.

Keywords
Executive functions, preschoolers, child development, low income, cross-cultural research

Introduction

Executive functions have become an umbrella term to refer to the highest level of cognitive processes. These include emotional control, focusing and sustaining attention, task orientation, prioritization, impulse control, and inhibitory control (Archibald & Kerns, 1999; Best, Miller, & Jones, 2009; Güler-Kenar, 2006). Sustaining attention is particularly necessary for planning, problem solving, and executing goal-oriented actions (Blair & Razza, 2007; Tominey & McClelland, 2011). Attention also helps children filter incoming information, shift their focus of attention from one task to another, and cope with distracting elements in a context (Rothbart & Posner, 2005). Inhibitory control, on the other hand, is the ability to stop a dominant response and replace it with nondominant response to demonstrate a less automatic but more adaptive behavior (McClelland, Cameron, Wanless, & Murray, 2007). Güler-Kenar (2006) also noted that executive functions also include the ability to solve problems with minimal effort so as not to interrupt other ongoing activities.

Research has shown that executive functions emerge during the early years of life and develop over the course of the life span and are influenced by the development of cognitive functions, behaviors, emotional control, and social interactions of children (Anderson, 2002). The development of executive functions is also affected by factors such as the child's age, cognitive maturity, and other individual differences (Archibald & Kerns, 1999).

Executive functions demonstrate both robust individual differences and remarkable developmental gains during these early years (Zelazo, Carlson, &

Kesek, 2008). In preschool children, interactions with caregivers and the environment are the primary influences on the development of executive functions (Rochette & Bernier, 2014). Interactions become more complex during preschool years due to the development of language abilities and social behavior (Fujiki, Brinton, Isaacson, & Summers, 2001). Attention, impulse control and self-regulation, and working memory abilities are the primary skills developed during this period (Razza, Martin, & Brooks-Gunn, 2012). During the preschool years, executive functions involving inhibition, shifting, and cognitive flexibility are also present (as cited in Peterson & Welsch, 2014). Notably, most studies of executive functions have been conducted within a western context.

Culture and development during the preschool years

Distinctive values depending upon cultural context influence a family, roles of parenting, childrearing practices, style, and beliefs (Kağıtçıbaşı, 1997; Music, 2011). Childrearing has always had as one of its first concerns across cultures the development of healthy and socially competent children (Berry, Poortinga, Breugekmans, Chasiots, & Sam, 2011; Music, 2011). Coll et al. (1996) note that members of families within a culture use every means available to help parents from the prenatal period to adolescence, even unto adulthood to some extent in some cultures, to raise their children. However, childrearing beliefs and practices may differ according to cultural values (Music, 2011). Indeed, research has shown that children from different cultures vary in their executive functions (Lucas, Lewis, Pala, Wong, & Berridge, 2013). These variances may be due to priorities and expectations of parents about their children in different cultures (Bornstein et al., 1996; Rothbaum, Pott, Azuma, Miyake, & Weisz, 2000). For example, American parents expect to have children with individualistic characteristics such as high self-esteem and self-independence, whereas parents from Puerto Rico put emphasis on characteristics that can be seen in collectivistic cultures such as sharing responsibilities and getting along with other people (Harwood, Schoelmerich, Schulze, & Gonzalez, 1999). Harwood et al. (1999) also found that the U.S. parents who give importance to autonomy of their children more than Puerto Rican parents do use practices that reinforce children's autonomy; on the other hand, Puerto Rican parents who give importance to obedience of their children more than the U.S. parents do direct their children by reinforcing interpersonal learning experiences of children. In the same perspective, Kağıtçıbaşı (1970) reported that Turkish parents emphasize obedience and compliance of children more than the U.S. parents do. Overall, findings are consistent with Vygotsky's (1978) sociocultural point of view that cultural context influences children's developmental trajectories. From this point of view, we attempted to examine how executive functions of children emerge in two cultural contexts: the United States and Turkey.

Executive functions and other areas of development

Of interest is the relation of executive functions to other areas of children's development. Interrelationships of executive functions to other developmental areas is plausibly explained by the maturation in the prefrontal cortex during early childhood leading to a rapid development of executive functions (Johnson, 2001), which then directly or indirectly supports other related behaviors (Blair & Diamond, 2008). For example, executive functions has the potential to affect the social adaptability of the individual (Diamond & Lee, 2011) and facilitates educational achievement (Fitzpatrick & Pagani, 2012) and adjustment from childhood to adulthood (Fitzpatrick, McKinnon, Blair, & Willoughby, 2014). Children's participation in a formal learning environment such as a preschool also allows for skills acquisition and learning in other developmental domains, which overlaps with the development of their executive functions (Fuhs, Nesbitt, Farran, & Dong, 2014). The brain-based explanation, proposed by Blair and Diamond (2008), for the development of executive functions and its relations to other areas of development suggests universality, but we note again that most studies have been conducted within the western context. Nonetheless, studies available to date demonstrate relations between executive functions and other areas of development.

Executive functions and motor development

Piaget's theory stressing the close interrelation of cognitive development and motor development is widely accepted, and current research findings show that these two areas of development are correlated in children who have developed in a healthy manner (Bornstein & Lamb, 2011; Roebers & Kauer, 2009). Research findings highlighted the effect of executive functions in tasks where motor coordination is assessed (Diamond, 2000; Diamond & Lee, 2011; Rigoli, Piek, Kane, & Ooestarlaan, 2012). These studies have shown that various skills requiring motor coordination such as ball skills (throwing and catching a ball), balance, and manual dexterity are associated with executive functions such as working memory, inhibition, delaying, and switching (Michel, 2012; Rigoli et al., 2012). In their study, Rigoli et al. (2012) found that children with poor motor coordination skills have more difficulty in complex tasks requiring speed and accuracy. In addition, Nigg (2000) noted that the abilities of inhibition and delaying require motor control to a great extent. Similarly, a growing body of research evidence shows that exercises such as aerobics improve prefrontal cortex activities and executive functions (Diamond & Lee, 2011).

In another study of three- and four-year-olds by Cameron et al. (2012), fine and gross motor skills and executive functions of children were assessed, and the

contribution of executive functions and multiple aspects of fine motor skills to their academic achievement was examined. Results indicated that executive functions and motor skills are positively correlated. In addition, high motor development and high executive functions significantly affected subsequent academic performance. While there are studies linking executive functions and motor abilities, there has not been one comparing more than one country to separate the universal from the cultural aspects of this link.

Executive functions and problem-solving skills

Executive functions play an important role in individuals' successful performance in life including problem-solving skills (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001; Jerauld, 2014). For example, Magalhaes (2013) found that executive function skills supported complex thinking and problem-solving skills of children. Relatedly, Zelazo, Carter, Reznick, and Frye (1997) pointed out that success in problem-solving skills require cognitive flexibility and inhibitory control, which are major components of executive functions.

In Bull, Espy, and Senn's (2004) study, where the planning and problem-solving skills of children were examined, the researchers noted that goal orientation required planning, monitoring, and thinking as part of the executive functions before executing their behaviors. Likewise, Zelazo et al. (1997) suggested that the problem-solving framework is composed of four distinct steps: problem representation, planning, execution, and evaluation. In the light of all these studies, there is evidence that executive functions improve problem-solving skills in the period of early childhood. We examined whether this is true in two cultural contexts.

Executive functions and personal–social development

Executive functions are also highly influential in social development and regulation of interpersonal interactions (Carlson, Mandell, & Williams, 2004). It is not surprising that one of the major goals of preschool is to establish classroom routines and teach expected school behavior, both in academic and social contexts. A rapid development in the executive functions of children between the ages of three and five not only increases their flexibility in thoughts and actions but also reduces their impulsive reactions to unexpected events (Barkley, 2001). As children progress into middle childhood, educators expect children to be aware of the behavioral and learning expectations of the school environment, and then the focus is shifted to mastering academic content. Studies have found that deficiencies in development of executive functions often lead to behavioral difficulties, including impulse control problems, slowed thinking, and attention difficulties (Nigg, Hinshaw, Carte, & Treuting, 1998). As a consequence, these

problems are also frequently accompanied by poor social skills (Norris & Tate, 2000).

Although literature on the relation between executive functions and personal and social development in the American context abounds, less evidence is available regarding this relationship in other cultural contexts. Thus, we investigated whether these relations are true across two different cultures.

Executive functions and communication skills

There are many studies indicating the close interrelation of language and executive functions. It was found in a longitudinal study that language skills in the early childhood years affect later executive functions (Hughes & Ensor, 2007). Another study found that executive functions of four-year-old children, who would start kindergarten, affected their language skills and school readiness during the year to a great extent (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008). Children with rich vocabulary skills were also found to have higher executive function scores than children with poor vocabulary skills (Espy, Bull, Martin, & Stroup, 2006). All of the aforementioned results indicate that language has a significant positive association with executive functions.

The importance of and the development of executive functions for children from impoverished backgrounds

It is well documented that children in poverty fall behind their peers in the development of early literacy and language skills (Beauvais & Jensen, 2003; Chapin, 2006; Zill et al., 2003). Recent longitudinal research with low-income children has investigated the impact of poverty (specifically the cumulative exposure to poverty-related stressors) on executive functions and has shown that children's executive function skills can be predicted by chronic exposure to poverty (Raver, Blair, & Willoughby, 2012). However, literature focusing on executive functions and its relations to other constructs as it pertains to low-income preschool-age children is not well developed. Nonetheless, a few studies have documented relations between executive functions and other domains including cognitive skills (Fitzpatrick et al., 2014), and receptive vocabulary and externalizing behavior (Razza, Martin, & Brooks-Gunn, 2010) among poor, preschool-age children.

Together, this limited but growing body of research suggests that, by addressing differences in executive functions in children from low-income backgrounds, and supporting the development of those skills, the achievement gap may be reduced. Greater understanding of the role of executive functions as it relates to other areas of development that have been implicated in the achievement gap can be helpful in planning integrative approaches to achievement gap interventions.

The current study

The above-mentioned studies indicate that executive functions emerge in early childhood and develop over the course of the life span. They also draw attention to the fact that executive functions of children develop in an interrelated manner with their cognitive skills, behavioral controls, communication skills, and social-emotional skills, and they help them cope with a wide range of everyday situations. Furthermore, there is empirical evidence relating poverty with various child outcomes, including physical, cognitive, and socioemotional development (Burchinal & Willoughby, 2013; Evans & Kim, 2013) as well as executive functions (Raver et al., 2012). The current study examines whether relations among executive functions and other areas of development are also prevalent among children from low-income families.

What remains to be tested is whether the development of executive functions differs according to cultural context. This study aims to investigate the relations between the general development levels and the executive function scores of preschool children from low-income families from an intercultural perspective in the U.S. and Turkey. The following questions are expected to be answered within the scope of the study:

1. Is there a difference in developmental domains or executive functions between Turkish and U.S. preschool-age children from low-income families?
2. Is there a difference in relations among developmental domain levels and executive functions between Turkish and U.S. low-income preschool-age children?

Method

Participation and data collection in both countries was completed through public or public/private schools.

In Turkey, 17 public preschools were visited by the researchers in order to conduct the study. Families participated in the study during the spring term of 2015; parents completed demographics and child development scales with the assistance of researchers after a parenting seminar, and executive functions of children were assessed individually with children by trained researchers.

In the U.S., the study was conducted in three Midwestern Educare programs, which are Head Start programs with additional quality features and adjacent to public elementary schools. Families were enrolled in the study in the fall of 2014; parents completed questionnaires with the aid of family support workers as part of the school intake process. Child developmental assessments were completed by parents and with the assistance of teachers in the fall and spring, and executive functions assessments were completed individually with children by trained research assistants during the month of the child's birthday.

Table 1. Descriptive statistics of the variables in the study.

Variable	U.S. *M* (*SD*)	Turkey *M* (*SD*)	Whole sample *M* (*SD*)	Min	Max	Scale range
Executive function	0.0046 (0.683)	−0.0662 (0.716)	−0.0325 (0.701)	−2.09	3.22	NA
Communication[a]	41.871 (16.504)	56.706 (18.914)	51.094 (19.413)	0	70	0–70
Gross Motor[b]	50.421 (11.956)	46.436 (16.837)	47.940 (15.294)	0	60	0–60
Fine Motor[b]	42.236 (15.589)	47.363 (16.792)	45.418 (16.524)	0	60	0–60
Problem Solving	46.143 (15.141)	39.050 (13.223)	41.751 (14.394)	0	60	0–60
Personal–Social[b]	50.839 (10.994)	48.947 (15.963)	49.670 (14.293)	0	60	0–60
Child age (in years)[b]	4.130 (0.568)	5.230 (0.536)	4.737 (0.804)	2.83	5.92	NA
Caregiver's age (in years)[b]	30.042 (6.001)	33.571 (7.594)	32.29 (7.255)	18.15	68	NA
Child gender (male)	55.1%	50.5%	52.1%			
Caregiver's education[b]				1	9	1–9
8th grade or less	6.3%	43.1%	27.9%			
Some high school	15.2%	4.9%	9.1%			
High school/GED	19.1%	32.4%	27.0%			
Some college	25.0%	2.2%	11.6%			
Tech						
Training/Certification	8.2%	0.5%	3.7%			
Two-year degree	11.7%	1.4%	5.6%			
Bachelor's degree	11.7%	13.9%	13.0%			
Master's degree	2.3%	1.4%	1.8%			
Doctoral degree	0.4%	0.3%	0.3%			

GED: General Equivalency Diploma; ANCOVA: analysis of covariance.

[a]To make the two communication subscales more equivalent, scores greater than 60 in the Turkish sample were excluded before conducting the ANCOVA. After creating two scales with range 0–60, results showed that there was no significant mean difference between the two groups.

[b]Indicates a significant difference between the U.S. and Turkey.

Participants

Table 1 presents a summary of the participants' demographic information and the descriptive statistics for the two countries. In Turkey, data were collected from preschools located in the regions which have the lowest socioeconomic level according to reports of Turkish Statistical Institute (2013) and Ankara Development Agency (2012). Ages and Stages Questionnaire (ASQ) data were available for 471 children, and data on executive functions were collected from 278 children. In the Turkish sample, 50.5% of the children were males, and mean age was 5.23 years (range from 2.83 to 5.92).

In the U.S., children and parents in the sample consisted of all families enrolled in three Educare programs. To qualify for Educare, all families were low-income or had a child with a disability but were from all parts of their respective communities. Families whose household income was at, or below the 2014 federal poverty threshold (annual income of $23,850 for a family of four before tax) are eligible to enroll in Educare. In all, ASQ data were available for 286 children, and executive functions data were collected from 252 children. In this sample, 55% of the children were male, and mean age was 4.12 years (range from 2.97 to 5.07).

Measures

Family Information Form. A demographic questionnaire was developed by the researchers in order to collect data for the Turkish sample. Identical family information was collected from the U.S. sample using the Educare Family Information Survey.

Ages and Stages Questionnaire. The ASQ is a screening tool, which aims to measure the communication, fine motor, gross motor, problem-solving, and personal–social development of three- to 72-month-old children. It is based on evaluations of parents. The first version of the ASQ was designed by Squires, Bricker, and Potter (1995). The questionnaire was adapted into Turkish by Kapçı, Küçüker, and Uslu (2010). For the U.S. sample, a newer version of the ASQ, the ASQ-3 (Squires & Bricker, 2009) was administered. This version is administered and scored in the same way as the ASQ but has one fewer item for the communication subscale. For both countries, the ASQ is completed by the parent or the caregiver of the child. Responses to the items are "yes," "sometimes," or "not yet" and are scored as 10, 5, or 0, respectively, in all five subscales. The sum of scores is the total score for each subscale.

The validity of the ASQ has been examined in different cultures, and evidence has shown that it is useful in a variety of settings (Singh, Yeh, & Blanchard, 2017). The reliability of the original form of ASQ was studied by examining the internal consistency, test–retest reliability, and interobserver reliability of the

questionnaires. The ASQ subscales have the following alpha values: .911 (Communication), .876 (Gross Motor), .895 (Fine Motor), .841 (Problem Solving), and .895 (Personal–Social). Test–retest reliability of the ASQ was examined by comparing two questionnaires completed by the same parent at a two-week time interval. The percent agreement for the 145 parents was 92%. Intraclass correlations (ICC; Shrout & Fleiss, 1979) ranged from .75 to .82, suggesting the ASQ has strong test–retest reliability. ICC by area ranged from .43 to .69, suggesting robust agreement between parents and trainer examiners when completing the ASQ on a group of 107 children. Moreover, internal consistency was acceptable with alphas ranging from .51 to .87. Sensitivity and specificity scores in the original form were 86.1 % and 85.6 %, respectively, while Turkish form showed 94% sensitivity and 85.5% specificity. Validity and reliability of the Turkish adaptation of the ASQ were also measured, and it showed acceptable interrater correlations from .76 to .93. The ASQ subscales have the following alpha values for the current Turkish sample: .911 (Communication), .876 (Gross Motor), .895 (Fine Motor), .841 (Problem Solving), and .895 (Personal–Social). The Turkish version of the ASQ (ASQ-TR) has equivalent items to the U.S. version, with a few exceptions. After consulting with a group of five Turkish professionals, eight mothers, and six preschool teachers about the cultural appropriateness of the translated/back translated ASQ-TR, an item was added to the Turkish version of the communication subscale, and a number of alterations were made in terms and expressions for cultural appropriateness. The ASQ-TR was found to have good internal, test–retest, and interrater reliability and adequate sensitivity, specificity, positive, and negative predictive value when a two-domain criterion was used to identify children are risk for developmental delays. This validation of the ASQ-TR was based on determining cut scores that best compared at risk categorization on criterion measures.

Preschool Self-Regulation Assessment. The Preschool Self-Regulation Assessment (PSRA) was developed by Smith-Donald, Raver, Hayes, and Richardson (2007), and the validation of the PSRA in Turkish was done by Fındık-Tanrıbuyurdu and Güler-Yıldız (2014). The ''Balance Beam,'' ''Tower Task,'' and ''Pencil Tap'' tasks from the PSRA were used to assess the executive functions of children in the current study. These tasks tap on executive control and attention of children during preschool years (Smith-Donald et al., 2007). Interrater reliability among raters was also assessed using ICC. ICC across three executive function tasks was found as .75 for Turkish raters and .92 for the U.S. raters, indicating acceptable reliability among raters.

Data collection training procedures were standardized across the Turkish and U.S. data collections. In both countries, each assessor was trained and supervised by an experienced assessor for the first several implementations. Following that, each task was conducted by an assessor and timed/scored by a second research assistant during the implementation. Balance beam was scored as

time in seconds as baseline, and two slow trials. Pencil tap score was the percentage of correct responses out of 16 trials. The tower task was scored in a categorical manner (0 = no taking turns, 1 = partial taking turn, and 2 = full taking turns). All scores from tasks were standardized and composited for total score (Smith-Donald et al., 2007).

Data collection process

For each measure, the approach used in Turkey is described first, and then the data collection processes used in the U.S. are detailed.

Before collecting data for the study, the researchers (Fındık-Tanrıbuyurdu & Güler-Yıldız, 2014) who adapted the PSRA scale into Turkish to assess the executive functions of children were contacted, and the permit to use the scale and necessary information was obtained. Similarly, the researchers (Kapçı et al., 2010) who carried out the adaptation study of ASQ were also contacted, and the necessary permits were obtained.

Preschool administrators were informed about the study. Training meetings on various subjects for parents were organized, and face-to-face meetings between the parents and the researchers were held. The parents were told the purpose and method of the study and how the study would be implemented at the end of the training meetings. ASQ forms were distributed to them based on the ages of their children, and the forms were filled out by them. Each item was read one by one to illiterate parents by the researchers, and they were guided in filling out the forms. In the U.S., consent was obtained during a parent meeting, but the ASQ was completed at a later date by the parent with guidance from the teacher during teacher visits to the homes. Teachers scored the data, and these were entered into a master data base.

The data for PSRA were collected in 2015. The PSRA tasks were administered to each child by a researcher, with a second researcher simultaneously taking notes of the child's performance. All tasks were carried out in empty classrooms allocated by the institutions attended by children. Class lists were obtained before carrying out the tasks, and children were called one by one for testing based on these lists. In the U.S., two research assistants escorted each child who was within 60 days of his/her birthday to a research room. One research assistant completed the tasks with the child and the second timed and recorded. Each assessment took about 15 minutes, after which the child was taken back to his/her classroom.

Data analysis

The measures were administered in each country using equivalent procedures and format, and this allows for cross-cultural comparison of scores. For this study, we only included questions and items which were present in both data sets.

The first step in the analysis was to run descriptive statistics for the whole sample and for each country (see Table 1). We also conducted analysis of covariance (ANCOVA) to test for differences in the variables between the two groups while controlling for child's age, maternal education, and gender. Using the maximum likelihood estimator in *MPlus* version 7.11 (Muthen & Muthen, 2012), we conducted a series of regression analyses for each group to examine the hypotheses of the second question. Finally, we conducted invariance testing of the pathways to determine if the model is equivalent for the two countries.

Ethics committee process

Necessary permits to carry out this study were obtained by the Ethics Committee of the University and the Ministry of National Education, in Turkey. Participation of parents and their children in this study was voluntary. Parents were informed about the research, and the voluntary parents signed the "Voluntary Participation Form" which protects their rights related to the research. The sensitivities of the parents were taken into consideration during the data collection period, and data were collected in a silent setting where the researcher and the participant are alone. In the U.S., the data collection project was approved by the University Institution Review Board (IRB). A second IRB review that involved cross-site de-identified data sharing across sites and countries was submitted and approved.

Results

Table 1 shows the means and standard deviations of the variables for each country, together with the participants' demographic information.

To answer the first research question, we conducted ANCOVA on the variables in the study to see the differences between the two countries while controlling for child's age and gender, and caregiver's education. As shown in Table 1, children from the two countries did not significantly differ on gross motor, $F(1, 421) = .127$, $p = .721$, and personal–social subscales, $F(1, 422) = .073$, $p = .788$. Turkish children scored higher in fine motor skills, $F(1, 422) = 9.352$, $p < .005$, whereas children from the U.S. scored higher in problem solving, $F(1, 421) = 11.557$, $p < .001$, and in executive functions, $F(1, 363) = 37.705$, $p < .001$. With regard to the communication subscale, it is not directly comparable given the difference in the number of items between the ASQ version administered in Turkey and in the U.S. To make the two communication subscales more equivalent, we first excluded the scores greater than 60 in the Turkish sample before conducting ANCOVA. Results showed that there is no significant mean difference between the two groups, $F(1, 301) = .488$, $p = .485$.

We also examined various demographic variables which can influence the relation between executive functions and the ASQ subscales. There was a

significant difference between the two countries in terms of children's age, $F(1, 627) = 715.293$, $p < .001$, with the Turkish children being older than the U.S. sample. In addition, the U.S. sample had a significantly higher educational attainment than the Turkish sample, $F(1, 623) = 61.421$, $p < .001$. Turkish caregivers were older than the U.S. caregivers, $F(1, 701) = 40.473$, $p = < .001$. There was no significant difference in gender composition, $F(1, 730) = 1.392$, $p = .239$, between the two groups.

To analyze the differences in relations among developmental domain levels and executive functions between Turkish and U.S. low-income preschool-age children, we conducted a series of regression analyses while controlling for demographic covariates (child's gender and caregiver's education). For the U.S. group, the higher the executive functions, the higher the ASQ communication ($B = 4.351$, $\beta = .203$, $p < .005$), fine motor ($B = 4.555$, $\beta = .216$, $p < .001$), problem solving scores ($B = 3.018$, $\beta = .167$, $p < .05$), and personal–social skills ($B = 1.709$, $\beta = .134$, $p < .05$). Female children also scored higher in ASQ communication ($B = 7.262$, $\beta = .243$, $p < .05$), fine motor ($B = 8.583$, $\beta = .291$, $p < .001$), problem solving scores ($B = 4.801$, $\beta = .191$, $p < .05$), and personal–social skills ($B = 4.095$, $\beta = .230$, $p < .05$).

For the Turkey group, the relation of caregiver's education to gross motor was approaching significance ($B = 4.538$, $\beta = .124$, $p = .051$). Additionally, caregiver's education predicted communication ($B = 5.968$, $\beta = .135$, $p < .05$) and fine motor ($B = 6.981$, $\beta = .181$, $p < .05$).

For the U.S. group, executive functions, along with the covariates, accounted for 11.8% of the variance in communication ($R^2 = .118$), 1.3% in gross motor ($R^2 = .013$), 15.6% in fine motor ($R^2 = .156$), 7.8% in problem solving ($R^2 = .078$), and 9% in personal–social scores ($R^2 = .093$). For the Turkey group, the predictors accounted for 2.6% of the variance in communication ($R^2 = .026$), 2.4% in gross motor ($R^2 = .024$), 5.3% in fine motor ($R^2 = .053$), 2.6% in problem solving ($R^2 = .026$), and 1.2% in personal–social scores ($R^2 = .012$).

To determine whether there were effects of gender and maternal education in interaction with executive functions in predicting ASQ subdomains, we conducted sensitivity analyses including interaction terms of gender × executive functions and maternal education × executive functions in the above models. Neither interaction term was significant; thus, we rely on the more parsimonious models as reported above.

We also conducted invariance testing of the paths between the predictors and each dependent variable to test model differences between the two countries. We first tested a configural model where all the pathways were allowed to vary. Then, we tested a model where all the pathways were constrained to be equivalent across the two groups. The constrained model showed adequate fit, $\chi^2 (15) = 18.887$, $p = .219$, comparative fit index = .997, Tucker–Lewis index = .991, and root mean square error of approximation = .035. We then used the H0 log likelihood estimate from the two models to compute for chi-square change, $\Delta\chi^2$

(15) = 9.444, $p = .85$. This result suggests that making the pathways identical for U.S. and Turkey did not result in a worse model and that all pathways are identical between the two countries.

Discussion

Findings of this intercultural study, which aimed to determine if differences existed in developmental domains between countries and in the relations between development levels of preschool-age children from low-income families and their executive functions in the U.S. and Turkey, are discussed.

Differences between U.S. and Turkish children in executive functions and ASQ subdomains

We found significant differences between the two cultural contexts in problem solving and executive functions (U.S. higher), and fine motor development (Turkish higher) but not in gross motor, personal–social, and communication. Turkish children and their parents in this study were older, while U.S. primary caregivers were more highly educated. While we used similar versions of both the ASQ (excepting the communication subscale, see Results section) and the PSRA to assess developmental domains, due to their administration in different languages, we utilized a conservative statistical approach with simple ANCOVA controlling for demographics while comparing countries. We discuss possible reasons for differences in three areas and not in three others and consider the contributions demographic variables could be making.

First, that American children in the sample were more advanced in problem solving and executive functions compared to Turkish children may be linked to different emphases placed on these domains according to social norms or cultural values (Coll & Magnuson, 1999; Kağıtçıbaşı, 1999). For instance, in an individualistic society like the U.S., children are taught early on to be independent and self-reliant. In collectivistic cultures, such as that of Turkey, interdependence is highly valued. Parents allow, if not train, their children, to rely on them and develop dependent behaviors (e.g. co-sleeping, spoon-feeding beyond toddlerhood) (Small, 2002). In addition, Turkish parents are more authoritarian than American parents, and they place more importance on obedience of children (Kağıtçıbaşı, 1970, 2012), whereas American parents tend to emphasize autonomy and self-expression (Coll & Magnuson, 1999) which may lend itself to development of problem-solving skills. Second, Turkish children were more advanced in *fine motor skills* compared to American children, and we attribute this to relative emphases in Turkish preschools on frequent cutting, drawing, buttoning, and writing exercises (Gallahue, 1982). For example, Ozkan and Girgin (2014) reported that 76% of the participant Turkish early childhood education teachers conducted art activities in their programs every day, and

painting, cutting, gluing, and origami aimed at developing fine motor skills were common during art activities. These activities are also offered in U.S. preschools but typically as choices among a range of activities, e.g. involving movement, construction, sand and water, and dramatic play (Marr, Cermak, Cohn, & Henderson, 2003). Our findings may also be related to the fact that Turkish children in the sample were slightly older than American children. While ASQ scores are age corrected, the positive correlation between maturity of small muscles and age (Liu, Hoffman, & Hamilton, 2017) may nonetheless have influenced findings in this area. Third, the difference between U.S. and Turkey on executive functions contrasts with results of Pala (2010), who found no difference between Turkish and British children. However, a difference between the Pala's study and ours is that our sample was comprised of low-income children and families. Executive functions have been found to increase with age (Etel, 2012; Pala, 2010), and because the Turkish sample was older on average, Turkish scores could have been higher, but that relation was not found. The mothers in the U.S. sample were more highly educated, and maternal education has been associated with higher levels of some dimensions of executive functions (Ertürk-Kara & Gönen, 2015). For this reason, we might have expected higher scores for the U.S. and, in fact, that was the case. However, we are reluctant to attribute the differences to maternal education. We did control for education in this analysis, but there may be factors that associate with education that we could not control. However, we attribute the differences to more general cultural differences, as described already, and to choice, variety and shifting required in U.S. preschools, such as the ones study children were attending. We point out that scores in executive functions for both U.S. and Turkish samples are comparable to findings of previous research on U.S. low-income children (Loman, Johnson, Westerlund, & Gunnar, 2012; Masten et al., 2012; Raver et al., 2011).

Patterns in U.S. and Turkey in relations between executive functions and ASQ subdomains and role of demographic variables

While we found different patterns between U.S. and Turkey in some regression analyses, rigorous invariance tests suggest that the country patterns were not reliably different from each other.

Thus, we initially examine the different patterns found as these patterns may be suggestive for future study. First, executive functions was a more pervasive variable in statistical prediction of other subdomains in the U.S. (fine motor, communication, problem solving) than in Turkey for which executive functions did not predict any subdomains. Moreover, executive functions together with covariates predicted from 1.3% (gross motor) to 15.6% (fine motor) of the subdomain variance in scores, while for Turkey, the models were less predictive with 1.2% (personal–social) to 5.3% (fine motor) of the variance in scores

predicted. Second, gender was a more predictive factor in relation to developmental domains in the U.S. than in Turkey. Third, maternal education played a stronger role in predicting developmental domains for the Turkish sample. We offer possible explanations and implications for these findings.

First, executive functions score was a predictor for more outcome variables in the U.S. than it was for Turkish sample. The Educare programs place strong emphasis on improving low-income children's self-regulation skills including executive functions as these are regarded as important foundations for children's school readiness (Blair, 2002). In addition, there is strong connection between Educare school/teachers and parents to improve parenting skills to scaffold children's social and cognitive development. In turn, this may help children to improve their executive functions and other developmental areas concurrently. While nonsignificant invariance tests suggest that little stock can be put in these different patterns by countries, the pattern findings suggest that the role executive functions plays in low-income children's development in different societal contexts be further investigated.

Second, gender predicted a number of ASQ subscales in the U.S. sample. Our finding that low-income girls fare better than boys in many subdomains of development is consistent with other studies of low-income preschoolers in the U.S. (Administration for Children and Families, 2002; Love, Chazan-Cohen, Raikes, & Brooks-Gunn, 2013) and has been attributed to various causes including early genetic superiority of females (Voyer & Voyer, 2014) and high rates of female-headed households among low-income families in the U.S. (U.S. Census Bureau, 2017). Our finding that the lack of association between gender and developmental outcomes in the Turkish sample is not commensurate with some previous studies (Çorapçi, Aksan, Arslan-Yalçin, & Yagmurlu, 2010; Kapçı et al., 2010). General trend in findings shows that girls score higher than boys on social outcomes (e.g. communication, personal–social development) (Çorapçi et al., 2010; Kapçı et al., 2010). Moreover, we were interested in determining whether executive functions *differentially* predicted ASQ subdomains by gender but that relation was not significant in our initial exploratory models.

Lastly, our regression results also suggest that maternal education seems to play a role in the Turkish context as maternal education predicted several developmental domains. These outcomes are consistent with those of Uluyurt (2012) who found that as the education level of parents increases, children's scores of hyperactivity, being excluded and being bullied decrease, and scores of developing social behavior to peers also increase. It may be that parents from higher levels of education are aware of children's social needs so that they provide better context for them to develop these skills (Okur & Corapci, 2016) On the other hand, mothers in the U.S. may rely on other resources (e.g. availability of community trainings, sufficient school resources for their children) such that education level did not significantly predict children's development in the domains of interest.

The conclusion that can be drawn from the regression analyses is that we did observe some different patterns in executive functions' predictions to other subdomains and in roles of gender and maternal education by country but that invariance tests did not demonstrate these to be significant differences. Thus, differences detected are descriptive, but they may suggest directions for future study.

Contributions and limitations

This study should also be interpreted in light of its limitations. First, the results only speak to correlation and not causation as we did not employ an experimental design. Even if we controlled for demographic factors, we acknowledge that there are potential variables which doubtless affected how executive functions impacted the developmental domains. For example, the quality and nature of preschool education that children receive, as well as the quality and nature of their relationships with caregivers and teachers, may also affect their development. Second, the use of two slightly different versions of instruments precluded direct comparison between the two countries in complex statistical models. For example, with the ASQ and ASQ-TR, measures included the same or similar items but in different languages, including differences in the ASQ/ASQ-TR communication subscale. For these reasons and because the validation of the ASQ-TR further emphasized cut scores versus continuous scores as we utilized in the current study, we took the conservative route and conducted parallel analyses versus one set of analyses with country as a predictor.

Despite its limitations, this study contributes to existing literature on executive functions in at least three ways. First, rather than relying on parent- or teacher-report, we used direct child assessments of executive functions but did rely on parent and teacher (U.S.) and parent report (Turkey) of other developmental domains to eliminate potential biases (e.g. social desirability). Second, the findings on the similarities and differences between the U.S. and Turkey extend our understanding of the complex ways that cultural context may be affecting children's early development. That we found descriptive differences in relations between executive functions and developmental subdomains—together with differences in roles played by gender and maternal education—adds to the story that culture matters and suggests future research. Psychological research, in general, focuses too narrowly on Americans, and this study contributes additional findings on executive functions and other subdomains in the Turkish context. Additionally, this research may be important in terms of developing effective interventions for supporting early development. Understanding broad or potentially universal features (and differentiating features) of executive functions and other domains may be helpful in design of early intervention programs to enhance early child development skills and in developing policies to strengthen educational opportunities for children from low-income households.

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