Impaired, Stable or Compensatory Trajectories of Intelligence and Memory among Adolescents and Adults with Down Syndrome: The contribution of Endogenous and Exogenous Factors on these Measures

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ABSTRACT

This study is divided into two parts. The aim of the first part was to examine the developmental trajectories of (crystallized and fluid) intelligence and (working and long-term episodic) memory among adolescents and adults with Down syndrome (DS) (IQ = 50-70) in four age cohorts: adolescents (age 16-21), adults (age 30-45), middle age (age 46-59) and seniors (age 60+). Cognitive development was tested in light of three possible models for the development of intelligence in populations with intellectual disability (ID) (Fisher & Zeaman, 1970): Impaired Trajectory (IT), Stable Trajectory (ST) and Continuous (Compensatory) Trajectory (CT).

The aim of the second part was to examine the contribution of endogenous variables (age, intelligence and physiological and functional changes with age), and exogenous variables (participation in cognitive leisure time activities) to intelligence and memory among participants aged 30 and older, based on the "Cognitive Activity" theory (CA) (Wilson & Bennett, 2003). According to this theory, in typical development populations, participation in cognitive leisure time activities during adulthood have an immediate effect on cognitive ability and may prevent cognitive decline and reduce the risk of Alzheimer's disease in the future.

Participants in the study were 80 adolescents and adults with DS in the four cohorts listed above, 20 in each group. Crystallized and fluid intelligence were tested using the Vocabulary, Similarities and Block Design subtests (Wechsler, 2001, 2010) and the Raven test (Raven, 1956, 1958). Working memory was tested using the Digit Span and the Spatial Span subtests (Wechsler, 1997b, 2001, 2010). Episodic memory was tested using Rey's Verbal Learning Test (Vakil & Blachstein, 1993, 1997; Vakil, Blachstein, & Sheinman, 1998).

The following results were obtained.

Part 1: Regarding the developmental trajectories of intelligence and memory from adolescence through adulthood, the hypothesis was partially confirmed. Scores for crystallized and fluid intelligence were higher during the period of adulthood than in adolescence. The scores in crystallized and fluid intelligence in adulthood were higher than in adolescence without any intervention, that is, the Continuous (Compensatory) trajectory. This verifies the "Compensation Age" theory (Lifshitz-Vahav, 2015), according to which life experience and maturity assist adults with intellectual disability to acquire cognitive skills that were absent from their cognitive repertoire. For verbal and visual-spatial working memory and for Rey Test measures, the hypotheses were not confirmed and a "Stable" developmental trajectory was found from adolescence through adulthood. It appears that the development trajectory for both typical and ID populations peaks in adolescence and remains stable through adulthood.

As for the period from adulthood to seniors (30-60+), we hypothesized stability in middle age and lower scores in senior age than in middle age. Here too, the hypothesis was partially confirmed. In vocabulary (crystallized intelligence), decline occurred during the senior period (60+) and in the "similarities" test in the 50s. In the Raven test of fluid intelligence, decline occurred in the 50s and in block design in the 40s. In verbal working memory and long-term episodic memory, a stable developmental trajectory was found and decline occurred towards senior age. In visual-spatial working memory, decline occurred in middle age.

Part 2: This part examined the contribution of endogenous variables (age, intelligence level and physiological and functional changes with age) and exogenous variables (participation in cognitive leisure time activities) to intelligence and memory measures only for the three oldest age groups. Questionnaires of physiological and functional changes with age and of participation in leisure time activity were used .

Lifshitz-Vahav, Shnitzer, and Mashal (2016) applied the Cognitive Activity Theory and found that cognitive leisure time activities do have an immediate positive effect on the cognitive

abilities of adults with intellectual disabilities, with and without DS. In light of this finding, we hypothesized that the findings of the present study would also demonstrate an immediate contribution of cognitive leisure time activities to participants' intelligence and memory. The hypothesis was confirmed as cognitive leisure time activity contributed to improvement in all the cognitive tests that were administered. It was also found that cognitive activity moderates the effect of physiological (health) and functional decline, which was also reported. These findings support the Compensation Age Theory (Lifshitz-Vahav, 2015), according to which both endogenous variables (age, intelligence and physiological and functional changes) and exogenous factors (such as life style and participation in leisure time activities) contribute to cognitive abilities in adults with intellectual disabilities.

In the theoretical domain, this study helps to expand the scope of knowledge about developmental trajectories of intelligence and memory in populations with DS from the adolescent period to and through the adult and senior years. In addition, the study helps to clarify the contribution both of physiological and functional changes with age and of life style as reflected in participation in leisure time activities, to the measures that were examined.

In educational-applicative terms, this study adds to the information base employed by policy makers, decision makers and service givers for dealing with individuals with intellectual disability. The study may help to clarify the importance of investing in the DS population in cognitive terms during adolescence and adulthood by means of varied learning activities and leisure time activities. The study findings also may help these agents to gain insight into the preparations needed to meet the decline in cognitive function with age.