

- 🌸 **Name of the study:** Development of Literal, Figurative and Narrative Language in relation to Intelligence Development among Ultra-Orthodox Adolescents and Adults with Intellectual Disability and Those with Typical Development: The Impaired, Stable and Continuous (Compensatory) trajectories
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Abstract

Linguists in the field of sociolinguistics who study the interplay between language and society, use the term "speech community". This term was first coined by Gumperz (1982), who defined it as a local social unit that characterizes each person according to their place and existence, of mutual connections within the unit. Over the years, various definitions have been formulated for this term, which can be summarized as "a unit of linguistic analysis based on social foundations" (Patrick, 2002). The characteristic of community speakers is that they use the same linguistic strategies that bear clear social and cultural significance to the group members, and also share a linguistic repertoire (Muchnik, 2006). In general, the language system in the Haredi (ultra-Orthodox) society includes Israeli Hebrew and *L'eshon Hakodesh* (lit. the Holy Tongue, the term used to describe the Hebrew language, in which the Scriptures were written, and which is used for religious, liturgical and *halacha* purposes) (Berman-Assouline, 2008). The main purpose of the current study was to examine the developmental trajectories of literal, figurative, and narrative language in adolescents (16-21) and adults (22-40) with non-specific intellectual disability (NSID), compared to individuals with typical development (TD) in the *Haredi* (ultra-Orthodox) sector, of the same chronological age.

In a factor analysis (CFA) with the Varimax rotation conducted by Lifshitz and colleagues (Lifshitz, Verkuiln, Shnitzer-Meirovich, & Altman, 2018) on language tests used in the present study, we confirmed that there are two orthogonal (distinct) factors that have the minimum loading of each item of 0.35. The first factor included the literal language tests: vocabulary, synonyms, classification and contrasts, while the second factor included the figurative language tests: analogies, homophones and idioms. Three judges (with a degree of reliability of 90% estimates between them) identified the literal language tests as representing the Crystal Intelligence, since their solution involves cultural and environmental experiences based on life-acquired knowledge and learning, whereas the figurative language tests were identified by the

judges as representing the Fluid Intelligence because their solution involves intentional and controlled abstract actions that cannot be performed automatically and cannot be acquired through environmental exposure. Therefore, we found it appropriate to examine the literal, figurative and narrative language trajectories development in connection with the development of the Crystal and Fluid intelligence trajectories development in a population with NSID compared to a population with TD.

It should be noted that intelligence trajectories in the population with ID (intellectual disability) and TD have been examined by us in a number of studies (Bustan, 2018; Chen et al., 2017; Lifshitz, Bustan et al., 2018), however, because the current study focuses on the *Haredi* sector, having its own distinctive discourse characteristics (Berman-Assouline, 2008), we found it appropriate to test the crystalline and fluid intelligence in this population as well.

Therefore, the operative objectives of the study are:

- A. To examine the developmental trajectories of crystalline and fluid intelligence in adolescents (16-21) and adults (NSID), compared to those with TD in the *Haredi* sector, of the same chronological age.
- B. To examine the developmental trajectories of the literal, figurative, and narrative language among the aforementioned research and age groups.
- C. C. To examine the contribution of endogenous variables (age, baseline cognitive level, gender) and the contribution of dependent variables (Crystal and Fluid intelligence) to explain the variance of the literal, figurative, and narrative language in both study populations.

The developmental trajectories of intelligence, and language development on its three strata have been examined, as stated, in accordance with three possible trajectories for the development of intelligence and cognitive ability in a population with ID compared to those with TD (Fisher & Zeaman, 1970; Lifshitz-Vahav, 2015): the impaired trajectory, the Stable trajectory and the Continuous trajectory. These trajectories are based on the traditional theories of intelligence in the general population (Kauffman, 2001) in which intelligence peaks around age 20, followed by an asymptote (resulting from an increase in crystalized abilities and a decrease in fluid abilities) until decline begins between ages 50 and 60.

According to the Impaired Trajectory (IT), the intelligence (crystalline and fluid) of individuals with ID develops for a shorter period than the general population, with their intelligence reaching its peak at approximately age 13-14, followed by asymptote and a decline beginning in the second decade, age 20-30. According to the Stable Trajectory (ST), the intelligence (crystalline and fluid) of individuals with ID develops similarly to that of individuals with TD, with the peak at approximately age 20, followed by an asymptote and a decline beginning in the sixth decade, age 50-60. According to the Continuous trajectory (CT), there is a delay in the development of

individuals with ID in their early years, but also compensation for that delay in later years, so their intelligence might develop into their 40s, followed by asymptote, and a decline beginning between ages 50 and 60.

The participants in the present study were individuals with mild to moderate NSID ($N = 60$, $IQ = 40-70$) who were compared to individuals with TD ($N = 60$, $IQ = 85-115$) in two age groups: upper adolescence (16-21) and adulthood (22-40).

The innovation of the study lies in its being the first to focus on the study of language in the *Haredi* population sector and simultaneously examining the developmental trajectories of three major components of the language (literal, figurative and narrative), in the population with ID from upper adolescence (16-21) to middle adulthood (40), and compared to those of typical development with the same chronological age.

The research results will be presented as they relate to its objectives:

Objective 1: To examine the developmental trajectories of crystalline and fluid intelligence in a population with NSID compared to a population with TD.

Crystal Intelligence: In a population with TD, there is an increase in crystal intelligence with age (McGrew, 2009). The "compensatory age" theory (Lifshitz-Vahav, 2015), argues that delay in the development of a population with ID in the early years has compensated in later years and that intelligence reaches its peak at age 40-45 (Lifshitz, 2020). Studies in the population with ID (Chen et al., 2017) indicate an increase in crystalline ability from adolescence to adulthood in this population. Therefore, we hypothesized that in both groups, the population with TD and in the population with NSID, there would be a rise in grades from adolescence (16-21) to adulthood (22-40).

Crystalline Intelligence was examined using sub-tests from the Wechsler battery, "Vocabulary" and "Equivalent" (Wechsler's Adult Test, WAIS-III^{HEB}; Wechsler, 2001; WISC-IV^{HEB}; Wechsler, 2010).

The results of the analysis of variance have found that adult scores (22-40) were higher than adolescents (16-21) in vocabulary and equivalent tests in both groups of study populations, among participants with TD and among subjects with NSID. The research hypothesis regarding the developmental trajectory of crystalline intelligence in a population with TD and with NSID has been confirmed.

Continuous (compensatory) trajectory to crystal intelligence is found in the population with NSID.

Fluid Intelligence: In typical development, during adulthood there is stability (Johnson et al., 2010; Ryan et al., 2000; Schaie, 2005, 2013) or decline (Hale et al., 2011; Kaufman, 2001; Monaco et al., 2013; Salthouse, 2004) in Fluid Ability. The "compensatory age" theory (Lifshitz-Vahav, 2015), argues that the delay in the development of a population with ID in the early

years has compensated in later years and that intelligence reaches its peak at 40-45 (Chen et al., 2017; Lifsjitz, 2020). Therefore, with regard to TD, we preferred to ask the question: whether a change would be found in fluidized intelligence during young adulthood (21-30), or middle adulthood (31-40)? Regarding the population with NSID, we hypothesized that there would be a rise in grades from adolescence (16-21) to adulthood (22-40).

Fluid Intelligence was examined using a sub-test from the Wechsler battery, "block design" (Wechsler's Adult Test, WAIS-III^{HEB}; Wechsler, 2001; WISC-IV^{HEB}; Wechsler, 2010), and the test "Colored Matrices of Raven" (Raven, 1956).

The results of the analysis of variance have found stability in scores between adolescents (16-21) and adulthood (22-40). A stable trajectory for Fluid Intelligence was found in the population with NSID.

Objective 2: To examine the developmental trajectories of literal, figurative and narrative language in a population with NSID compared to a population with TD in two age periods: upper adolescence (16-21), and adulthood (22-40) in affinity to three possible developmental trajectories: Impaired, Stable and Continuous (compensating).

Literal language: Due to the fact that this language is analogous to crystal intelligence, we hypothesized that in both study population groups there would be an increase in grades from adolescence (16-21) to adulthood (22-40).

The literal language was examined using a naming test (Kave, 2005b), which aims to test vocabulary naming. In addition, three sub-tests were used: synonyms, opposites and classification tests, from the MANN test (Glenz, 1989), which aims to test abstract verbal thinking and verbal mental abilities.

TD group: It was found that in the naming test the scores in adulthood (22-40) were higher than the scores in adolescents (16-21). In the other literal language tests: classification, synonyms and contrasts, no differences were found in scores between adolescents (16-21) and adulthood (22-40). This may be due to the fact that these tests were design to a young age (Glantz, 1989) and were influenced by the Ceiling effect.

NSID group: In this group too, there were no significant differences between the grades in adulthood (22-40) and the grades in adolescence (16-21).

In order to examine in depth the difference in grades from adolescence to adulthood, and due to the broad age range of the adult group (22–40), we divided the adult group into two subgroups. In this way, we referred our findings to three age groups: adolescence (16-21), young adulthood (22-30) and middle adulthood (31-40). In the population with TD, there were no differences in scores in the literal language tests between the three age groups: adolescence (16-21), young adulthood (21-30) and middle adulthood (31-40). In the population with NSID the grades in middle adulthood (31-40) were higher than the grades in young adulthood (22-30) and of those

in the upper adolescence (16-21), on naming, classification, synonyms and contrasts tests. In other words, subjects' with NSID scores in the literal language reach their peak in later adulthood (middle maturity).

The research hypothesis as to the developmental trajectory of literal language in the population with NSID as a continuous (compensatory) trajectory, has been confirmed.

Figurative language: Since this language parallels to fluid intelligence, which is characterized by stability or decline from adolescence to adulthood in a population with TD, as to this population, we found it difficult to speculate and asked: would a difference be found between adolescents (16-21) and adults (22-40)?

Regarding the population with NSID, according to the "compensatory age" theory (Lifshitz-Vahav, 2015), and studies in the population with ID (Lifshitz, Bustan & Shnizer-Meirovitz, in press ; Chen, et al, 2017), suggesting an increase in fluidity from adolescence to adulthood, We hypothesized that there would be an increase in grades from adolescence (16-21) to adulthood (22-40).

The figurative language was examined using three tests: The Homophone Meaning-Generation Test - HMG (Mashal & Kasirer, 2011), which aims to test the ability to produce different meanings for the same word. The equivalent derivation test from the MANN test (Glanz, 1989) aiming to test abstract verbal analogue ability, and the test of idioms (Mashal & Kasirer, 2011), aiming to test ability to understand the meaning of figurative idiom of language.

TD group: It was found that there was no difference in scores between adults (22-40) and adolescents (16-21), nor in the distribution of adults into two age groups: young (22-30) and middle-aged (31-40), in the three figurative language tests (homophones, analogies and idioms tests).

NSID group: Adults' scores (22-40) were found to be significantly higher than adolescents' (16-21) in homophones. The scores in middle adulthood (31-40) were higher than the scores in young adulthood (22-30) and from the scores in adulthood (16-21) in the analogue test. In our study, we did not find a unified developmental trajectory describing the development of all factors examined in the context of the figurative language in population with NSID. A stable trajectory was found for analogue and idioms tests and a continuous (compensatory) trajectory for the homophone test.

Narrative Language: Researchers (Barton-Hulsey et al., 2017; Heilmann et al., 2010; Peterson et al., 2010) distinguish two components that underlie narrative language: the microstructure component and the macrostructural component, varying in complexity throughout narrative language development.

The microstructural component is linguistic and includes knowledge of vocabulary, semantics and syntax, acquired from exposure to learning and culture, and thus this language is

associated with crystal intelligence. The macrostructural component is cognitive and includes working memory skills, causality, abstract thinking and conclusions that are not acquired through learning, and thus this language is also associated with fluid intelligence (Barton-Hulsey et al., 2017; Heilmann, et al., 2010; Peterson, et al., 2010).

The narrative language was examined by using a story generating test with the free textbook *Frog Where are You* (Mayer, 1969) (Finestack & Abbeduto, 2010; Heilmann et al., 2010).

Various indice were produced: Linguistic microstructural indices such as: length of speech, linguistic complexity, syntactic complexity and linguistic complexity, as well as cognitive macrostructural indices such as: presentation of the opening and ending of the plot, use of mental statements and references, resolution of conflicts and coherence.

Since the narrative language is related to the two types of intelligences, we asked the research question: Will there be differences in the narrative language between the different age groups? Will there be interaction between research groups and age groups in story production ability?

TD group: It was found that the scores of the adults (22-40) were higher than the adolescents' scores (16-21) on microstructural and macrostructural measures. Subdividing the subjects into three age groups found that the scores were higher in the micro and macro indices in young adulthood (22-30) and middle adulthood (31-40) than in adolescents (16-21).

NSID group: It was found that the scores of the adults (22-40) were higher than the adolescents' scores (16-21) in the micro and macro indices. In the subdivision of the three age groups, it was found that the micro-scores were higher in young adulthood (22-30) and middle adulthood (31-40) than in adolescents (16-21). Macro scores were higher in middle adulthood (31-40) than in young adulthood (22-30) and adolescent (16-21).

It has been found that the narrative language developmental trajectory in the population with NSID is a continuous (compensatory) trajectory.

In conclusion, our findings from the various analyses of the literal and narrative strata, according to which the scores in adulthood (22-40) are higher than the scores in adulthood (16-21), indicate a trend of the continuous (compensatory) trajectory in the development of language in a population with NSID.

The findings confirm the 'compensatory age' theory (Lifshitz, 2020; Lifshitz-Vahav, 2015).

Apparently, life experience and maturity help the population with ID in acquiring skills that are absent from the cognitive repertoire.

Objective 3: Testing the contribution of endogenous variables (age, baseline cognitive level, gender) and the contribution of dependent variables (crystal and fluid intelligence) to the explanation of the variance of literal, figurative, and narrative language in the two study populations.

In order to examine the contribution of demographic and intelligence metrics to explain literal, figurative and narrative language ability, in each of the study groups, regression analyses were conducted using the step method. In the first stage of the regression model, subjects' demographic background indices: gender and chronological age using step-wise manner were introduced. In the second stage of the regression model, subjects' scores were entered in both the crystalline intelligence tests and the two fluid intelligence tests using a step method. The use of the step method is designed so that only variables that clearly predict the literal, figurative, and narrative ability to fit into the model.

TD group: It was found that chronological age contributed significantly (25.6%-27.4%) to understanding literal language in the naming test and to understanding narrative language in the macrostructural indices. As for the contribution of the type of intelligence, it was found that the fluid intelligence contributed significantly (37.7% -15.3%) to understanding literal, figurative and narrative language. This means that population with TD relies primarily on Fluid intelligence: in literal language in the naming test, in figurative language in the idioms and analogies tests, and in narrative language in the microstructural index of linguistic complexity. Fluid intelligence, compared to crystal intelligence, is more closely related to the g-factor of general intelligence that includes the ability to solve abstract problems that are independent of experience, culture, and learning.

NSID group: The chronological age was found to contribute significantly (6.8%-24.2%) to the understanding of the three strata: literal language in the naming test, figurative language in the homophone test, and narrative language in linguistic microstructural measures of linguistic length and linguistic stage. Regarding the contribution of the type of intelligence, it was found that only crystal intelligence contributed significantly (17.9%-42.3%) to the understanding of the three strata of the language: literal language in naming tests, classification, synonyms and contrasts, figurative language in analogue, idioms and homophonic tests, and narrative language: the macrostructural metrics of use of mental statements, conflict resolution and coherence.

The conclusion is that a population with NSID relies more on crystalline intelligence that includes essentially semantic verbal associative knowledge that emerges and evolves with the rise in chronological age, whereas a population with TD relies more on the Fluid intelligence which is more closely related to the g-factor of intelligence, that includes the ability to solve abstract problems that are independent of experience, culture, and learning.

The theoretical contribution of the study is to expand the knowledge of the developmental trajectories of language among a population with NSID from adolescence to adulthood. Clinical contribution emerges from the findings which will help determine the worthwhile investment in

the language development model to achieve optimal development, and will, as well, improve the quality of life of a population with NSID during adolescence and adulthood.



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