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The Effects on Brain Structures, Social and Cognitive Skills in Children Exposed to the Guri Santa Marcelina Program in Greater São Paulo: A Quasi-Experimental Study

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Abstract

The question guiding this study is: how can participation in the Guri Santa Marcelina Program affect the development of social skills, cognitive abilities and brain structure in children aged between 6 and 7? Among the observational studies used in the health area, the quasi-experimental design verifies the causal relationship between exposure to a situation and the prognosis of an outcome. It has been widely used in research in situations where conducting a randomized control study would be unethical. This study will be used here for reasons inherent to the process of enrolling in the Program, prospectively throughout the 2020 school year, when data will be collected from the internal group (50 children) exposed to the Program and the control group (100 children, 50 of whom will be randomized to MRI), in order to measure, through this observation, the effects that the predictor (being exposed to the Program) has on the outcome variable (social and cognitive skills and changes in brain structure). Parents or guardians will sign the Informed Consent Form at the time of enrollment. The aims of this research are: 1) to evaluate the social effects of the Guri Santa Marcelina Program of the São Paulo State Department of Culture on children aged 6 and 7 in the communities served by the program using the ABEP economic classification criteria (2018), the SDQ questionnaire (Goodman & Goodman, 2011) of abilities and difficulties, the Questionnaire of Aggressive and Reactive Behaviors among Peers (Q- CARP; Borsa & Bandeira, 2014), verbal working memory (WISC-IV), concentrated, divided and sustained attention BPA (Rueda, 2013) and Raven's Colored Matrices test (Raven, Raven, & Court, 2003); 2) to observe possible structural changes in the brains of children exposed to the intervention of the Guri Santa Marcelina Program in 6 and 7 year olds by means of magnetic resonance imaging (MRI). Results of research conducted on programs inspired by the Venezuelan project based on orchestral music teaching known as El Sistema showed a significant improvement in students' academic performance when compared to the control group (Holochwost et al., 2017b), cognitive (Habibi et al., 2016), socio-emotional and musical (Ilari et al., 2016). Similar results in a study conducted by Alemán et al. (2016) corroborate the behavioral benefits of children exposed to social vulnerabilities. In Brazil, although there are several social music education projects (Ação Social pela Música do Brasil - ASMB in Chapéu Mangueira, Alemão, Macacos, Cidade de Deus, Piraí, João Pessoa, Rondônia, Neojibá in Bahia, Projeto Guri in the interior and coast of São Paulo, Instituto Baccarelli, formalized in 1996 in the city of São Paulo, and Guri Santa Marcelina in Greater São Paulo), there are no quantitative studies or studies that have used imaging exams to measure the prognosis that exposure to social programs focused on music education presents as an outcome.

Attachments

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Materials

Research design

This is a longitudinal study with a *quasi-experimental* design. This design makes it possible to verify, like a randomized controlled trial, the effect of a given exposure (Guri project) to a situation and the prognosis of an outcome (our behavioral, cognitive and neuroimaging measures). However, some analytical and sampling precautions and the selection of *control* variables (see below for *control instruments)* are fundamental when planning the study, since the quasi-experiment does not have randomization, which is fundamental to avoid biases arising from confounders that could alter the chance of a given child participating in the Guri project or not (for more details, see the literature on causality and the principle of ignorability (Greenland & Mansournia, 2015). This type of design has been widely used in research in situations where conducting a randomized control study would be unethical or even impossible for logistical reasons, such as intentionally exposing people to risk factors (e.g. cigarettes and asbestos). Considering our context, it would not be possible, given the functioning and structure of the Program itself, to selecta group of children who had never had music lessons and from this initial selection, randomly draw those who would participate in the Guri project and those who could not participate in the Guri project during the period of almost a year of study. We thought of proposing to Guri that after a year, the children who had been randomly selected for the control group would be put on a waiting list and would have the possibility of being guaranteed a place for the followingyear; however, such a procedure is neither acceptable nor ethical in view of Guri's structure. In short, we chose this mode of study, since it would be impossible, for ethical reasons inherent in the democratic process of enrolling in the Program [The program does not have a selection process. Although there is a waiting list, which could function as a controlgroup in the randomized study, it would be unethical to forcethe children on thislist to wait a whole year before they can enroll, since, due to dropouts, it is possible to get a place during the year.], to conduct a randomized study, which is the *gold-standard* design within classical biostatistics in the process of causal inference (Boutron, Altman, Moher, Schulz & Ravaud, 2017; Greenland & Mansournia, 2015).

Control instruments

Questionnaire of economic classification criteria from the Brazilian Association of Research Companies - ABEP (2018). Created to assess socioeconomic status based on household samples, it contains 9 items that assess a) ownership of durable consumer goods; b) type of water supply system and street paving; c) number of residents in the household; d) family composition; e) level of education of the head of the household. The result of the questionnaire is a measure stratified into 5 socio-economic classes: A (subdivided into A1 and A2), B (also subdivided into B1 and B2), C, D and E.

Raven's Colored Progressive Matrices (CPM) - Special Scale (Raven *et al.*, 2003): an instrument used to assess non-verbal intelligence, analogical reasoning and eductive ability in children aged 5 to 11. It is one of the most widely used instruments for assessing non-verbal intelligence in children and adults (Lúcio *et al.*, 2017; Pasquali, Wechsler, & Bensusan, 2002). It has 36 items divided into three series with 12 items each, in gradual order of difficulty: series A, Ab and B. Each item in the series is made up of a figure with a piece missing, and the child's task is to indicate the figure that completes the missing part within the 6 answer options presented. The maximum score for the task is 36 points and the intelligence classification is given in percentiles. A participant who scores in

the 5th percentile (V classification) is at risk of intellectual difficulties and will therefore be excluded from the sample.

Test instruments

Strengths **and** *Difficulties* **Questionnaire (SDQ**) - The *Strengths and Difficulties Questionnaire* is a validated measure, translated and culturally adapted into more than 15 languages, with references that help us to have internationally standardized measurement parameters. The questionnaire was originally developed by Goodman (1997), with the most recent version by Goodman and Goodman (2011), and aims to provide a screening of behaviors, emotions and relationships of children and adolescents. It has been validated and adapted for Brazilian Portuguese (Stivanin, Scheuer, & Assumpção, 2008; Woerner *et al*., 2004). The questionnaire has two versions, which can be answered by parents or teachers (the same items, adapted for the respondent). There are 25 statements that must be answered on a 3-point Likert scale, made up of the options: false, more or less true and true (for example: "are you kind to younger children?"). The 25 items are organized into 5 dimensions (emotional symptoms, conduct, hyperactivity, relationship problems and pro-social behaviour). Some items are reversed on the scale (e.g. in the hyperactivity section, if you answer "false" to the question "thinks before acting", you score 2 points; but if you answer"is constantly restlessor agitated", you score zero points. This implies that the higher the score, the greater the difficulties. Similarly, in the case of strengths (sociability), they increase as the scores increase. The result of each scale can be evaluated if at least 3 items are scored. A score of 0 to 40 is given for difficulty items (sociability items are scored from 0 to 10). There is a second part containing impact information, or assessing stress and general impairment, which must be answered ifthe parent or teacher answers yes to the first question (if they answer negatively, they score zero and the application is stopped). If the impact supplement shows a score of 0, it is considered normal, 1 borderline and 2 abnormal.

Psychological

Battery for the Assessment of Attention (BPA, Rueda, 2013) - this is a set of subtests that assess three domains of attention: concentrated attention (the ability to focus, select and maintain attention on target stimuli and ignore competing stimuli); divided attention (the ability to pay attention to more than one stimulus at the same time, responding to the different needs of the environment); and sustained attention (the ability to switch attention from one stimulus to another). The test presents validity and accuracy studies and norms for people between 6 and 82 years of age.

WISC-IV Digits Subtest (Wechsler, 2013): assesses verbal working memory and verbal working memory. Sets of numbers are presented to the children in ascending order (2 to 8 sequences) and the children must repeat them in the same order (direct digits) or in the reverse order (inverse digits) in which the numbers were presented. Each item has two attempts, and the subtest is interrupted when the child misses two attempts at the same item. The score for each attempt is one point. Thus, the maximum score in each subtest subdivision (direct or inverse) is 16 points, giving a total subtest score of 36 points.

Questionnaire on Aggressive and Reactive Peer Behavior (Q-CARP) - a questionnaire translated and adapted into Brazilian Portuguese by Borsa and Bandeira (2014). The questionnaire contains a total of 20 questions asked by the applicator to the child, involving two different scales: the Aggressive Behavior Scale - ACE, made up of five items that assess physical and verbal aggression (e.g. kicking or slapping) and three control items that are not scored and serve as a control (e.g. telling jokes). These items refer to the frequency of behaviors and are asked as "howoften does it happen to you ", with each item having a 4- point Likert scale (every day, sometimes, infrequently and never). The Aggression Reaction Scale (ARS)

consists of 12 phrases that represent different ways in which children commonly react to aggression from their peers. The question asked of these items is "when a classmate of yours" followed by the statements, which can signal aggressive reactions (e.g.: hits or pushes you, do you hit your classmate?) or other forms of reaction, such as seeking support (e.g.: hits or pushes you, do you tell the teacher?) and internalized emotional reactions (e.g.: hits or pushes you, do you cry and get punched?).

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