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The Brain's Semantic Network Distinguishes Algebra from Arithmetic

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Abstract

Analyses of brain activity revealed that arithmetic activated more of the bilateral supplementary motor area, left insula and left inferior parietal lobule, while algebra activated more of the angular gyrus. For algebra, significant brain-behavior correlations were found in the semantic network, including the middle temporal gyri, inferior frontal gyri, dorsomedial prefrontal cortices and left angular gyrus. Interindividual single-trial brain-behavior correlation The phonological network, which included the precentral gyrus and supplementary motor area and the visuospatial network, which included the bilateral superior parietal lobules, contained the significant brain-behavior correlations for arithmetic. The visuospatial and semantic networks were found to have significant positive functional connectivity in algebra, while only the visuospatial and phonological networks were found to have significant positive functional connectivity in arithmetic.

Keywords: Systems biology • Algebraic model reduction • Identification

Introduction

According to Shaul and Seger in Biochim Biophys Acta (BBA)-Mol Cell Res 1773 (8): 1213–1226 (2007), the MEK/ERK signaling pathway is involved in cell division, cell specialization, survival and cell death. A polynomial dynamical system proposed to describe the MEK/ERK dynamics is the subject of our investigation here their experimental setup, data and known biological data. Following activation of either wild-type MEK or MEK mutations linked to cancer or developmental defects, the experimental dataset is a time-course of ERK measurements in various phosphorylation states. Model reduction, identification and parameter inference of MEK variants can be aided, respectively, by means of techniques from computational algebraic topology, differential algebra, computational algebraic geometry and computational algebraic geometry. We demonstrate throughout how this algebraic perspective permits a thorough and methodical analysis of such models [1].

Literature Review

Algebra is a branch of mathematics that deals with symbols and the rules of manipulating these symbols. The symbols used in algebra, such as letters and other characters, represent numbers and other mathematical objects. This allows us to solve mathematical problems using equations and other symbolic representations. Algebra is an essential part of mathematics and is used in various fields, including science, engineering, economics and computer science. Algebra is often divided into two parts: elementary algebra and abstract algebra. Elementary algebra deals with the manipulation of equations and expressions involving real and complex numbers, while abstract algebra involves the study of algebraic structures, such as groups, rings and fields [2,3].

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Discussion

One of the fundamental concepts of algebra is the equation, which is a statement that two expressions are equal. Equations can be solved to find the values of the variables involved. The process of solving an equation involves applying mathematical operations, such as addition, subtraction, multiplication and division, to both sides of the equation until the variable is isolated. For example, consider the equation $3x+5=11$. To solve for x, we can start by subtracting 5 from both sides of the equation, which gives $3x=6$. Next, we can divide both sides by 3, which gives $x=2$. Therefore, the solution to the equation is $x=2$. Algebra also involves the manipulation of expressions, which are combinations of variables, constants and mathematical operations. Expressions can be simplified by combining like terms and applying mathematical operations. For example, consider the expression $3x+2y-5x-4y$. To simplify this expression, we can combine the like terms, which gives $-2x-2y$ [4].

Algebraic expressions can also be evaluated for specific values of the variables. For example, if $x=2$ and $y=3$, then the expression $3x+2y-5x-4y$ can be evaluated as follows:

$3x+2y-5x-4y$

$=3(2)+2(3)-5(2)-4(3)$

$=6+6-10-12$

$= -10$

Algebra also involves the use of functions, which are mathematical objects that relate an input value to an output value. Functions can be represented using algebraic expressions and equations. For example, consider the function $f(x) = 2x+3$. This function takes an input value x and outputs a value that is twice the input value plus 3. We can evaluate this function for a specific value of x, such as $x = 4$, by substituting 4 for x in the expression and simplifying as follows:

$f(4)=2(4)+3$

$=8+3$

$=11$

Algebra also involves the use of graphs to represent mathematical relationships. Graphs can be used to visualize functions and other algebraic relationships. The graph of a function is a visual representation of the input-output relationship of the function. The graph of a function can be used to find the domain and range of the function, as well as to identify key features such as intercepts, maxima and minima. For example, consider the graph of the function f(x)=x^2-4x+3: The graph of this function is a parabola that opens upward and intersects the x-axis at x=1 and x=3. The vertex of the parabola is at (2,-1), which is the minimum point of the function. The domain of the function is all real numbers.

In the introduction, we mentioned that the linear framework's range of application is still unclear. The framework provides a different, based on graph theory, approach to Markov processes (4). Regarding biochemical reaction networks, the information in 3 suggests that the framework can be utilized when the acyclic metagraph that describes how enzymes interact with their substrates is used. In light of this, we hypothesized that a simplified version of the RPT might hold true. Although a recursive structure with fixed points could be discovered here (3), this restriction excludes systems in which enzymatic action occurs along pathways that feedback, which would produce cyclic metagraphs. In contrast to networks with more complex dynamics, such as limit cycles, the framework can also be applied to the analysis of networks that reach steady states [5].

Conclusion

Arithmetic and algebra are frequently used to conceptualize and represent mathematical expressions. The combination of digits and operators such as 8(1+3) is the concrete representation of arithmetic. Contrarily, algebra has a more abstract form than arithmetic and includes abstract operations with letters and operators (like a (b+c)). The neural mechanisms underlying the dissociation between algebra and arithmetic that has been demonstrated in previous studies remain unknown. Using functional magnetic resonance imaging (fMRI), the current study looked at how brain networks separate algebraic and arithmetic processing.

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Conflict of Interest

None.

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