A systematic review of computational modeling of interpersonal dynamics in psychopathology

Autores: Orestis Zavlis, Giles Story, Claire Friedrich, Peter Fonagy, Michael Moutoussis

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Objetivos:

> ✍️ A systematic review of computational modeling of interpersonal dynamics in psychopathology, p.933
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> > In this study, we aim to address these queries by systematically reviewing extant computational modeling of interpersonal dynamics in psychopathology.

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> > . Our primary aim is to evaluate whether these computational approaches can offer both theoretically notable and methodologically reliable insights about interpersonal psychopathology.

> Para entender os objetivos do artigo, é necessário compreender o significado de algumas terminologias:

> ✏️ **Definição**
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> interpersonal dynamics: refere-se a maneira que um indivíduo se relaciona com ele mesmo e com o outros a sua volta, incluindo **atribuição de responsabilidades** ("isso é minha culpa"), **dedução mental** e **estratégias sociais**; quando desenvolvidas, elas tem fomentam

qualidades positivas individuais, porém podem ser um "tiro no pé" se mal estabelecidas.

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Essas dinâmicas interpessoais podem ser avaliadas experimentalmente e sistematicamente através de ferramentas computacionais. Tais ferramentas, justamente pela capacidade de produção científica psiquiátrica, vem se tornando populares, contudo, não há literatura (afirmado pelo artigo) que sustente a validez metodológica.

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Dessa necessidade de sistematização, surge o objetivo do estudo, já descrito no bloco acima, mas aqui reforçado: determinar, ou pelo menos fornecer bases futuras, para a utilização evidenciada de modelos computacionais na análise de relações interpessoais.

Metodologia:

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> > To cover the entire spectrum of computational methodologies, we include both theory-driven and data-driven approaches

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> > Our systematic review was prospectively registered (PROSPERO CRD42024488821) and adhered to the PRISMA guidelines

É uma revisão que segue o protocolo PRISMA de revisão sistemática. Foram utilizadas 5 bases de dados (MEDLINE, Embase, PsycINFO, Web of Science and Google Scholar) na data de 10 de junho de 2025; o percentual de captura dos artigos sobre psicologia é de 90%, segundo Bramer.os critério de avaliação incluem:

ⓘ **Critérios de inclusão e exclusão**

(1) were written in English, (2) were either empirical or theoretical, (3) employed any of the following computational frameworks (Bayesian, reinforcement learning, dynamical systems and machine learning), (4) examined interpersonal dynamics and (5) examined any psychopathology. Studies were excluded if they: (1) did not examine any psychopathology (2) did not assess interpersonal dynamics or (3) did not employ any computational methodologies

A procura dos estudos foi realizado por dois pesquisadores e avaliados segundos os termos de *risco de viés*, *validade*, *performance* e *transparência*. para risco de viés, foram utilizadas as ferramentas NIH risk assessment tool e PrObAST risk assessment tool. Para validade, fora utilizado a ferramenta Validity Appraisal Guide for Computational Models (VAG-CM). Para performance, modelos baseados em teoria (theory-drive models) utilizaram-se de test-retest reability, parâmetro de recuperação e ajuste de modelo, enquanto para modelos baseados em informação (data-drive models) utilizaram-se validação interna, validação externa e previsão de performance, ainda usando métricas descritas em: link externo. Para transparência, foram avaliados os critérios de informações disponibilizadas, código disponibilizado e protocolos pré-registrados

Resultados:

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Study Description

This section outlines a theoretical synthesis of our 58 included studies (Table 1), as well as two additional studies that were considered relevant despite not meeting inclusion criteria. Please refer to Supplementary Tables 1 and 2 for more details on these studies.

Dos 4198 estudos encontrados, apenas 58 foram selecionados após as etapas do protocolo PRISMA.
Aqui estão os achados para cada modelo computacional encontrado:

✎ Random Dynamical Systems

Dynamical systems outline how sets of variables evolve over time based on a set of 'rules'. These rules are installed in systems of equations: specifically, differential equations that define changes in continuous time (dt = seconds) or difference equations that define changes in discrete time (t = Monday, t + 1 = Tuesday and so on).

Dynamical systems have been used to study how therapeutic relationships evolve over time and how interpersonal asynchronies map on different psychopathologies (Box 1). Some studies have applied these systems to formalize novel relational patterns, such as the unstable relationship dynamics of borderline personality disorder , the social motives of autonomy versus mergence and the nonlinear interactions of seminal therapeutic constructs (for example, mentalizing with selfefficacy).

⚡ Reinforcement Learning

Reinforcement learning suggests that humans, other animals and machines act so as to maximize long-term rewards. This idea of reward maximization has its origins in traditional behaviorist views in psychology (that is, operant conditioning) and can be operationalized in two ways: model-free learning and model-based learning.

Reinforcement learning has been used in a predominantly empirical way to decipher both transdiagnostic and disorder-specific patterns of social learning (Box 2). Transdiagnostically, studies have implicated low self-esteem to blunted social learning (for example, difficulty updating negative self-beliefs) and adolescent experiences of relational trauma to unstable and credulous social learning (for example, 'This person was untrustworthy but may now be trustworthy')

⚡ Approximate bayesian inference

Bayesian inference suggests that human beings update their beliefs in an (approximately) Bayesian way, using Bayes theorem

> $P(\text{cause}|\text{observation}) \propto P(\text{cause})P(\text{observation}|\text{cause})$

Bayesian models have been used both empirically (to understand how humans form social beliefs) and theoretically (to understand similar dynamics in simulation studies) (Box 3). Empirically, many studies

converged in showing that various mental disorders (from anxiety to borderline personality disorder and psychotic disorders) are typified by difficulties in updating beliefs about themselves and others. Other studies have extended this line of research by investigating meta-cognitive beliefs: that is, beliefs about beliefs . Such studies have showcased that people with autism are typified by an inability to engage in this form of 'deep' social reasoning ('I think that you think that I think' and so on), as well as that their social difficulties, emerge mainly in situations that necessitate this form of reasoning (a problem known as 'double-empathy') .

Machine Learning Models

Machine learning is a broad class of algorithms that aim to learn from observed data to make predictions about unobserved data. These learning algorithms can be grouped under at least three categories: supervised learning, unsupervised learning and reinforcement learning (as explained in Box 2).

Machine learning studies focused on three distinct topics: classifying, predicting or linguistically exploring psychological phenotypes (Box 4). Although classification studies revealed novel variables that could classify attachment styles (for example, anxiety from posting more emotional social media posts and avoidance from receiving more likes on such posts)66 and psychosis (for example, from social and cognitive functioning), they were generally deemed of low quality because they were predicated on small sizes (for example, 30–90 participants per group).

Economic Models

Although outside the scope of this review, two notable studies using economic models were considered relevant. These studies examined ways of navigating relationships, showing that acting 'unfairly' and being 'closed socially' are common in those with psychopathy and borderline personality , respectively.

Dos estudos analisados, cerca de 38% deles apresentaram um risco alto de viés, e 31% de risco moderado, de acordo com as ferramentas já citadas.
A avaliação de validação encontrou 4 tipos de artigo descritos abaixo:

> ✏️ **Validação**
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> Our validity assessment revealed four types of model:
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> 1. data-driven models (5/9 dynamical systems, 9/18 Bayesian models and notably all reinforcement learning models)
> 2. theory-driven models (2/9 dynamical systems and 3/19 Bayesian models)
> 3. theory-driven models with strong generative validity (2/19 Bayesian models)
> 4. excellent models scoring high on all types of validity (2/9 dynamical systems and 4/10 Bayesian models).

> Em transparência, os resultados foram baixíssimos (avaliar sessão doa artigo)

Síntese de discussão e conclusões:

> O estudo encontrou que modelos "theory-driven" conseguiam formalizar conceitos alusivos historicamente (como mentalização, por exemplo), enquanto modelos "data-driven" era capazes de mapear sistematicamente esse conceitos em problemas psicopatológicos diversos. Contudo, por mais dos achados, muitos problemas surgiram invariavelmente aos critérios de avaliação positivos do artigo especificado.
> Foram três os desafios encontrados na computação psiquiátrica social:
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> 1. modelos "theory-driven" estavam incompletos em estudos empíricos e de machine learning
> 2. Baixa transparência geral
> 3. Integração metodológica fraca, com apenas dois artigos fazendo-o.
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> Os pesquisadores afirmam que mesmo com o cenário atual pessimista, existem quatro caminhos para avanço do área. O primeiro é a melhora da transparência dos próximos estudos; o segundo é ampliando a confiabilidade e viabilidade dos métodos computacionais padronizado e direcionando-os para processos relacionais particulares; o terceiro é abraçar a natureza complementar dos métodos computadorizados e integrá-los a métodos empíricos e teóricos; o quarto, por fim, investir em métodos "data-driven" em aplicações clínicas.
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> Concluindo, existe sim potencial nos modelos computacionais para entendimento de psicopatologias interpessoais, por mais dos desafios.

Informações adicionais

> Material Suplementar

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