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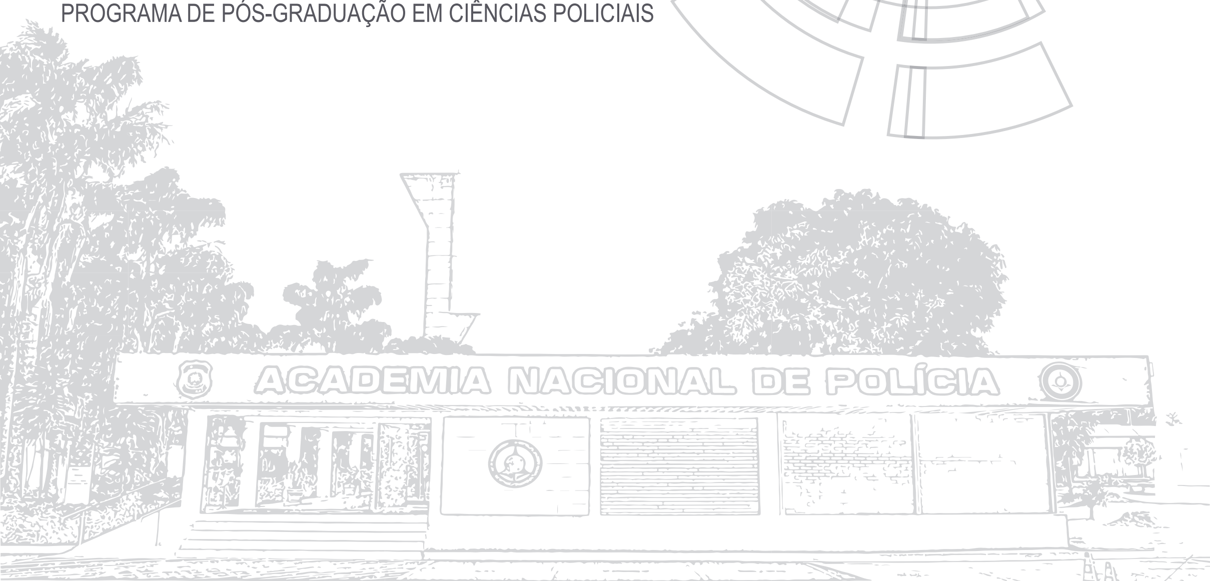


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REVISTA BRASILEÑA DE CIENCIAS DE POLICÍA

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# Social forecasting: A literature review of research promoted by the United States National Security System to Model Human Behavior


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## ABSTRACT

The development of new information and communication technologies increased the volume of information flows within society. For the security forces, this phenomenon presents new opportunities for collecting, processing and analyzing information linked with the opportunity to collect a vast and diverse amount data, and at the same time it requires new organizational and individual competences to deal with the new forms and huge volumes of information. Our study aimed to outline the research areas funded by the US defense and intelligence agencies with respect to social forecasting. Based on bibliometric techniques, we clustered 2688 articles funded by US defense or intelligence agencies in five research areas: a) Complex networks, b) Social networks, c) Human reasoning, d) Optimization algorithms, and e) Neuroscience. After that, we analyzed qualitatively the most cited papers in each area. Our analysis identified that the research areas are compatible with the US intelligence doctrine. Besides that, we considered that the research areas could be incorporated in the work of security forces provided that basic training be offered. The basic training would not only enhance capabilities of law enforcement agencies but also help safeguard against (unwitting) biases and mistakes in the analysis of data.



**Keywords:** Intelligence analysis. Human behavior. Social network. Complex network. Game theory.





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## Introduction

The development of new ICTs (information and communication technologies) increased the volume of information flows within society. For the security forces, this phenomenon is paradoxical. While it presents new opportunities for collecting, processing and analyzing information linked with the opportunity to collect a vast and diverse amount data, at the same time it requires new organizational and individual competences to deal with the new forms and huge volumes of information. The vast amount of information available surpasses the human capacity to process each piece of data individually. Thus, the excess of information may not be able to reduce uncertainty (CORNELIUS, 2005; CAPURRO, 2007); in fact, given its entropic character, the excess of information may withdraw the organizational or individual capacity for knowledge construction and representation.

The informational online environment can also be used by adverse agents to carry out their illicit activities. For instance, terrorism recruitment and propaganda for terrorist acts have been executed online in the same networks people use for social interactions (FONSECA; LASMAR, 2017). The relevance of dealing with this phenomenon is illustrated by recent initiatives from the European Union with a project to research how individuals become radicalized based on the analysis of open source behavioral information (PROPHETS, 2018). Furthermore, the Internet can also work as a platform for psychological and deception operations (BRITO, 2015).

Thus, all these challenges require a new set of knowledge within the security forces which, in line with the legal framework in each country, have to identify these and other kinds of illicit activities while, at the same time, respecting the privacy right of users.

Thus, it is important to understand what the scientific research areas are that are of potential interest to security forces related to the collection and analysis of information about human behavior in order to cope with the vast amount of information available. With this objective in mind, we carried out a literature analysis of the research promoted by defense or intelligence agencies of the United States.

The reason to focus on the USA is that since World War II, the US National Security System (US NSS)[1] has exercised great influence on research and development of ICTs, such as the Internet, digital computer, and the Global Positioning System (GPS). Thus, the US NSS is an important benchmark in order to have an exemplar about the security technologies related to behavioral analysis and the collection of information.

## Methods

In a previous work (MACIEL; BAYERL; KERR PINHEIRO, 2019), we analyzed the scientific output promoted by the US National Security System (NSS). To this end, we collected 82239 scientific papers, funded either by US defense or intelligence agencies. These documents were first clustered into research fronts (RF's)[2]; the research fronts were then aggregated into technological paradigms. In this process, we identified 33 technological paradigms. In this, the US NSS output thus provided evidence which was further analyzed using scientometric methods to identify the technological paradigms therein.

To carry out the detailed literature review focused specifically on human behavior analysis, we selected, from the full dataset, the documents and research fronts of the paradigm labeled *Social forecasting* (figure 1). The paradigm comprised 2688 documents, separated into 63 research fronts. The documents were mainly published in *Mathematics and computer science* journals. However, we note some individual research fronts were also classified into other science fields, such as *Social sciences and humanities* and *Physical sciences and engineering.*

In order to separate the research areas, we needed to create an intermediate classification. This is necessary because 'research front' is a very strict aggregation criterion for documents, leading to small subsets (on average 75.24 documents per research front). Thus, using the map of research fronts that the links calculated based on textual similarity as

1 We call the US National Security System the set of defense and intelligence agencies at the federal level which participate in the intelligence community or in the National Security Council.

2 Research fronts are localized efforts of scientists in 'unsolved puzzles'. Their nature is "discontinuous, starting and ending abruptly as scientists move from one puzzle to the next" (MORRIS *et al*., 2003).

input, we executed a second round of clustering. For this, we used the VOSviewer[3] algorithm (ECK; WALTMAN, 2010) with the standard resolution value (1.0). This procedure aggregated the research fronts into five clusters. In order to give insight into these clusters, we carefully reviewed the top-10 most highly cited publications[4] in each one. With this procedure, we gained knowledge about the most relevant papers funded by the US NSS through the eyes of the external audience. For each cluster, we also created a term map using the methodology incorporated in the VOSviewer software (ECK; WALTMAN, 2011).

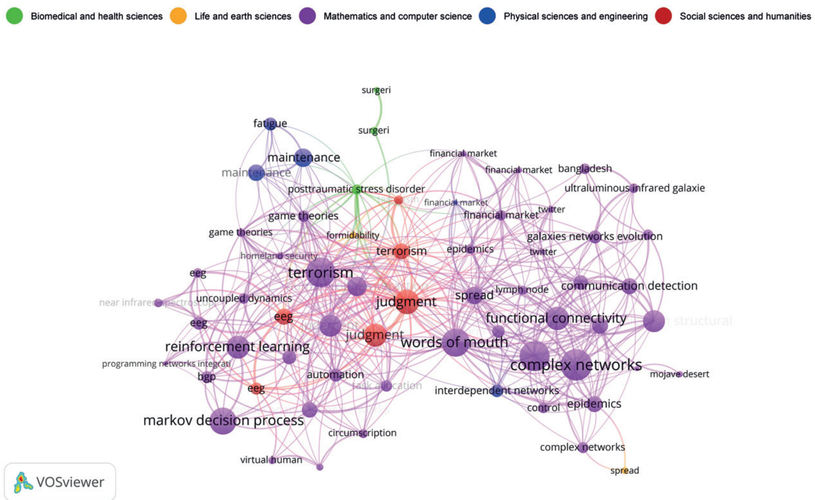


Figure 1 Science classification of RF's with respect to Social forecasting. The size of each circle represents the number of documents, while the distance represents the textual similarity.

## Results

Figure 2 shows the five clusters, which resulted from classification of the research fronts. Based on their content, we labeled the clusters as[5]:

3 http://www.vosviewer.com/

4 The number cited offered by the Web of Science Database was considered.

5 An interactive visualization of the results presented in this work can be seen in the app available at https://rodfileto.shinyapps.io/technological_trajectories/. In this app it is possible to visualize the research fronts of all technological paradigms promoted by the US NSS. In order to visualize detailed features of the research fronts, which comprise the results presented in this article, we

a) Complex networks

b) Social Networks

c) Human reasoning

d) Optimization algorithms

e) Neuroscience

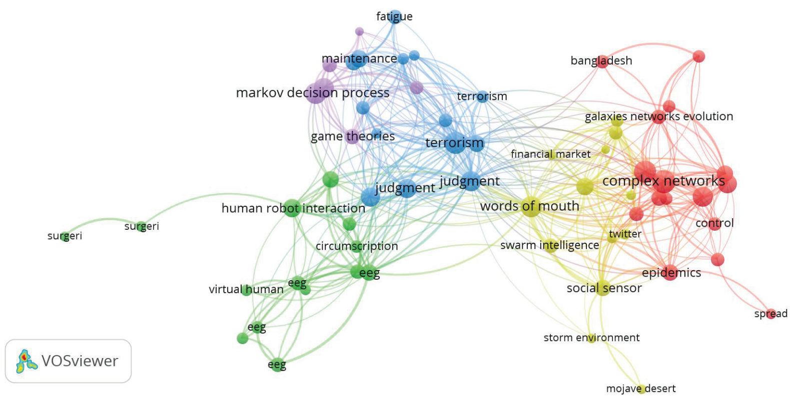


Figure 2 Science map of RF's. The size of each circle represents the number of documents, while the distance represents the textual similarity. Each color represents the cluster considered for literature review. The clusters are complex networks (red), social networks (yellow), human reasoning (blue), optimization algorithms (purple) and neuroscience (green)

## Complex networks

This cluster comprises 1386 documents (29.24 % of the total). As shown in the map of terms (figure 3), the cluster covers research related to complex networks.[6] The main terms are graph (in mathematics, the graph theory is a broader term, which includes the study of networks), node, edge, and algorithm.

invite the reader to visit the app and check the paradigm "Social Forecasting".

6 As stated by NATURE (2019), "complex networks are networks that feature patterns of connection between their elements that are neither purely regular nor purely random". Most of the real-world networks are considered complex, such as the Internet, power-grid and transportation.

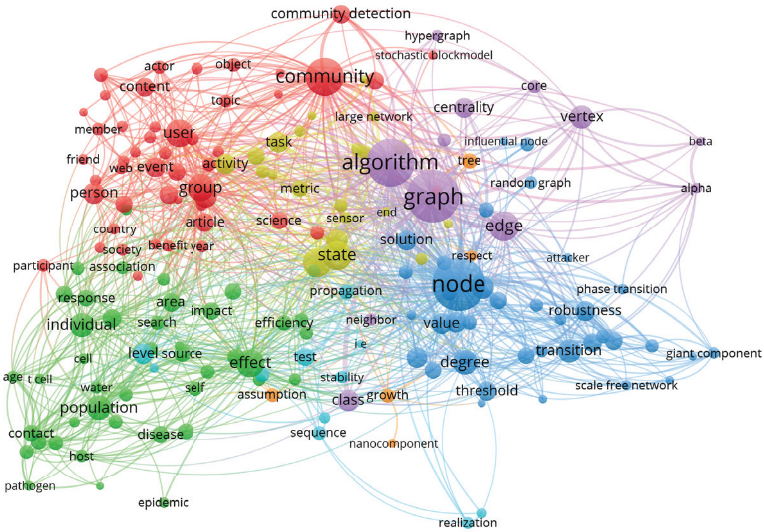


Figure 3 Map of terms related to the cluster 'Complex networks'. Different from the previous maps, the colors do not represent scientific fields. In this case, the colors were used for highlighting similar terms.

One theme present in most documents of this cluster is the analysis of interdependent networks. In contrast to isolated networks, interdependent networks consist of a set of networks whose operation is linked and dependent one each other. For instance, a bidirectional one-to-one coupling exists if between two networks A and B, each node of  has one link (dependence) with one node  and vice versa. The research interest, among others, is to understand how interdependent networks behave concerning the percolation threshold.[7]

Havlin *et al*. (2010), through mathematical simulation, show that, in general, interdependent networks are more vulnerable (compared to a single network), since removing a small fraction of nodes can activate a cascade of failures. Additionally, Gao *et al*. (2011) assert that due to cascading failures, the vulnerability increases with the number of coupled networks and, in the case of a loopless network of

7 Percolation is understood as "the emergence of a giant cluster when nodes (or links) are sequentially added to the network"; or thinking from the opposite perspective, shrinking of a giant cluster occurs when nodes or links are excluded from the network (HAVLIN *et al*., 2010). The percolation threshold is the stage of transition between a nonzero giant component to a giant component with size zero after sequentially removal of nodes or edge.

networks, the percolation threshold is dependent only on the number of networks and not on the topology. Huang *et al*. (2011) confirm these findings through the simulation of attacks in high or low degree nodes of interdependent networks. They show that the strategy to defend high degree nodes is effective in isolated networks, but is ineffective in coupled networks.

The proposition of Schneider *et al*. (2011) is twofold. They suggested a new measure of robustness of networks in order to mitigate the impact of malicious attacks and, based on that, proposed a way to rearrange the links between the network in order to improve its robustness at low economic costs. Their measure is considered supplementary to the percolation threshold, since there are situations, the authors argue, where the "network suffers a big damage without completely collapsing" (SCHNEIDER *et al*., 2011, p. 3838). There is still the analysis of how the percolation threshold, combined with network clustering, affect disease spreading (MILLER, 2009).

Another subject in the cluster is about community detection in complex networks.[8] Xie, Kelley and Szymanski (2011) reviewed the state of the art in overlapping community detection algorithms[9] concerning the quality and speed of the algorithms. Regarding real-world applications, the authors argue that the ambiguity in the definition of overlapping nodes imposes a challenge to evaluate the quality of the algorithms. A special case of community detection is brought by Bassett *et al*. (2011), which analyzed the process of brain configuration during a learning activity. Their temporal analysis showed that the brain regions are functionally organized in modules (communities). Another characteristic of community identification in a real-world case, more specifically about the relationship between geographical space and network community, was studied by Onnela *et al*. (2011). The results showed that geographical centrality of nodes is uncorrelated with

8 The community concept implies the existence of groups inside a network, which share links more strongly "with other members of the community than they do with vertices of the other communities" (FORTUNATO; HRIC, 2016, p. 7).

9 Overlapping community detection intents to identify the communities in a network allowing some nodes to be part of more than one community.

the node centrality on the network. Besides that, the geographical span increases smoothly as long as community size is up to 30; above this value the geographic span increases dramatically.

## Social networks

This cluster comprises 749 documents (15.80% of the total). As shown in the map of terms (figure 4), the cluster covers research related to social network analysis. Thus, the main terms are related to human interactions in digital-online networks, such as *twitter, individual, human mobility, agent,* and *group*.

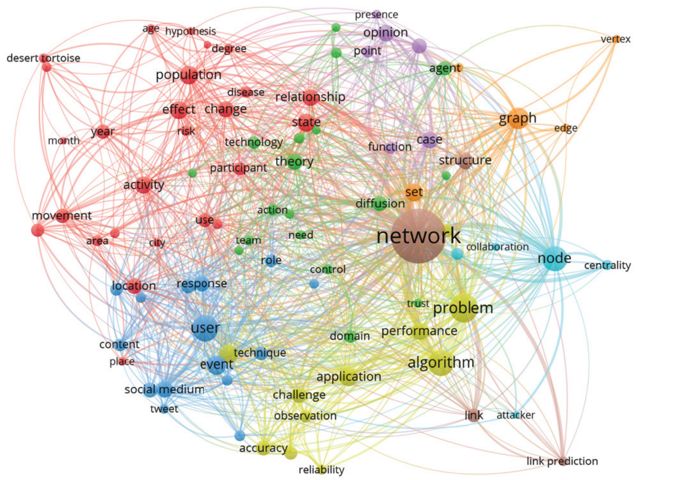


Figure 4 Map of terms related to the cluster 'Social networks'. The colors were used for highlighting similar terms.

One main theme of the cluster is the modeling of human mobility through the collection and analysis of online networking data. The initial research, conducted by Song *et al*. (2010b), used recorded trajectories of millions of mobile phone users in order to evaluate the predictability of human mobility. Their results show that most of the humans are well localized in a finite neighborhood, but that a few travel very widely. Furthermore, they calculated that there was no user predictability under 80%. This research area also comprises articles concerning the modeling of individual trajectories, also based on information from phone call metadata (SONG *et al*., 2010a; DEVILLE *et al*., 2014).

The modeling of human mobility is also present in the works of Arenas *et al*. (2011), which analyzes the self-initiated behavioral responses given an epidemic event. Their model shows, counter-intuitively, that in an epidemic "the increased flow of individuals going through alternative paths brings the infection to new sub-populations that would otherwise be infected by other sub-populations" (ARENAS *et al*., 2011, p. 5). Simini *et al*. (2012) introduced the radiation model, a parameter-free modeling platform, in order to predict mobility. The model relies on population densities, information which is accurately estimated throughout the globe and which can offer analysis even in places where information about transport patterns are not collected systematically.

Another subject covered is the study of individual information gathering for decision making. The two main studies are very similar in their approach and findings. Preis, Moat and Stanley (2013), and Curme *et al*. (2013) analyzed fluctuations in queries for financial terms/pages, in Google trends and Wikipedia respectively, and found that increases in information gathering precede falls in stock market prices. Alanyali, Moat and Preis (2013) created a corpus of issues of the Financial Times newspaper in order to quantify the relationship between volume of news about a company and its daily transactions in the stock market. They arrived at the conclusion that the volume of trading and change in price for a company is correlated with the mentions of the company in the news. However, their analysis provided no evidence of a relationship concerning the direction of the price.

## Human reasoning

This cluster comprises 1214 documents (25.61 % of the total). As shown in the map of terms (figure 5), the cluster covers themes about human decision making concerning psychological factors that affect behavior and risk assessment (terms such as *uncertainty, decision making, and assessme*nt). There is also research with respect to factors considered by terrorists to carry out an attack.

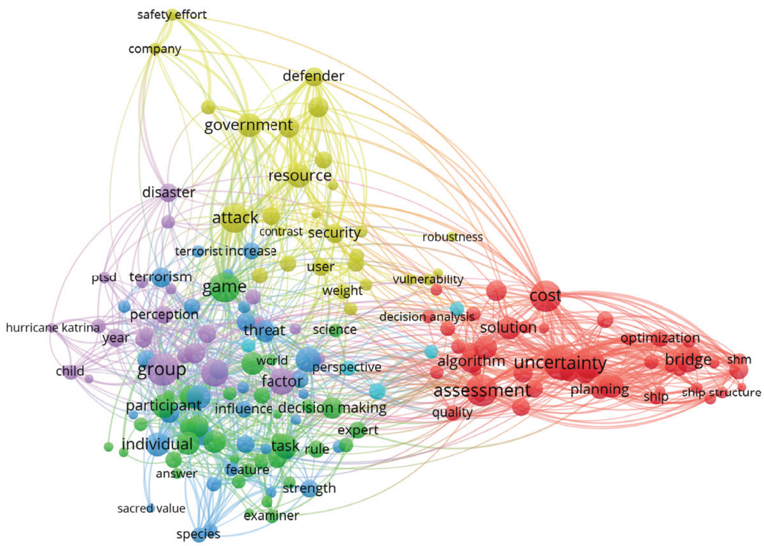


Figure 5 Map of terms related to the cluster 'Human reasoning'. The colors were used for highlighting similar terms.

One theme present in the cluster concerns the assessment of how humans use abstract knowledge to make decisions and predict future events even without, or with limited, prior experience. In the center of this approach is the mathematics of Bayesian statistics, which models how abstract knowledge guides inference from incomplete data. The work of Tenenbaum *et al*. (2011) provides a literature review about the potentialities of this approach in the cognitive psychology. Teglas *et al*. (2011, p. 1057) found that 12-month old infants "can represent the crucial spatial, temporal, and logical aspects of dynamic scenes with multiple objects in motion and integrate these cues with optimal context-sensitive weights to form rational expectations consistent with a Bayesian observer model." Nonetheless, the cluster also includes some debates about the non-considered assumptions behind the Bayesian reasoning. Jones and Love (2011) call Bayesian fundamentalism the excessive use of Bayesian statistics at the expense of theoretical development. Therefore, they argue that this approach implicitly considers that human behavior can be explained on a strictly rational analysis. Still, Jones and Love (2011) acknowledge that Bayesian models bring interesting aspects such as algorithms and approximations by which inference is carried out, the representations on which those algorithms operate, and the structured beliefs that drive them. As put by the authors, “the Enlightened Bayesian view takes these seriously as psychological constructs and evaluates them according to theoretical merit rather than mathematical convenience. This important shift away from Bayesian Fundamentalism opens up a rich base for psychological theorizing, as well as contact with process-level modes of inquiry” (JONES; LOVE, 2011, online).

The importance of considering the factors that affect human rationality is illustrated in the work of Kassin, Dror and Kukucka (2013), which evaluated the confirmation bias in forensic activities. They found that several factors can increase a tendency for confirmation bias. We highlight the context effect, in which the consideration of additional information such as confessions may bias the evidence analysis. Another facet of human reasoning covered in the cluster is risk assessment in environmental sciences (Linkov *et al*., 2009; Huang, Keisler and Linkov, 2011) and terrorism risk assessment (Ezell *et al*., 2017).

## Optimization algorithms

This cluster comprises 513 documents (10.82 % of the total). As shown in the map of terms (figure 6), the cluster covers the optimization algorithms, with game theory as the main approach (represented for instance by the terms *strategy, agent, and game).*

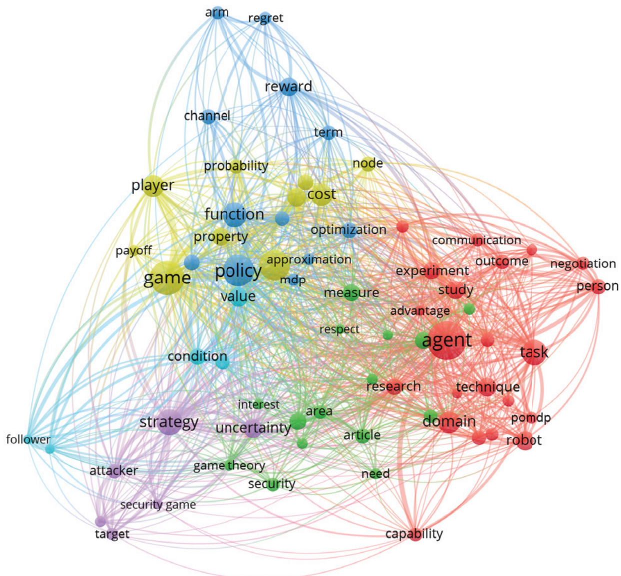


Figure 6 Map of terms related to the cluster 'Optimization algorithms'. The colors were used for highlighting similar terms.

*Game theory* is considered as a rich set of mathematical tools for modeling multi-person strategic decision making. In general terms, a game is defined as a triplet with a set of players, set of strategies and a set of payoff functions (Hossein Manshaei and Zhu, 2013). Thus, the model calculates the best response function of a player in relation to all the remaining players' strategies. Additional assumptions are considered, such as games where players have imperfect information. In the cluster, game theory appears as an important design choice for distributed resource allocation algorithms (LI; MARDEN, 2013). These algorithms can be used for modeling optimal resource allocations for network security (HOSSEIN MANSHAEI; ZHU, 2013, KORZHYK *et al*., 2011), or to implement coordination between a camera network in order to optimize target sensing (DING *et al*., 2012). In the former, the game is composed of defenders and attackers which try to maximize gains relative to privacy and communication. In the latter, the cameras themselves are the players and the maximized function has the objective to capture the image with the best quality of a target. The planning of airport security is a further application of the game theory approach (PITA *et al*., 2009; JAIN *et al*., 2010).

Another algorithm identified in this cluster is *reinforcement learning*. This method differs from supervised learning, where the correct pairs of input/output are presented to the agents. In reinforcement learning the agent is instead offered feedback concerning the objective. Given this feedback the agent modifies its actions in order to correct and improve future actions. This algorithm is used to implement optimization of small cell networks (POOR *et al*., 2013) and in robotics (KONIDARIS *et al*., 2012; KOBER; BAGNELL; PETERS, 2014).

## Neuroscience

This cluster comprises 878 documents (18.52 % of the total). As shown in the map of terms (figure 7), the cluster covers themes about human behavior (represented by the terms *group* and *train).*

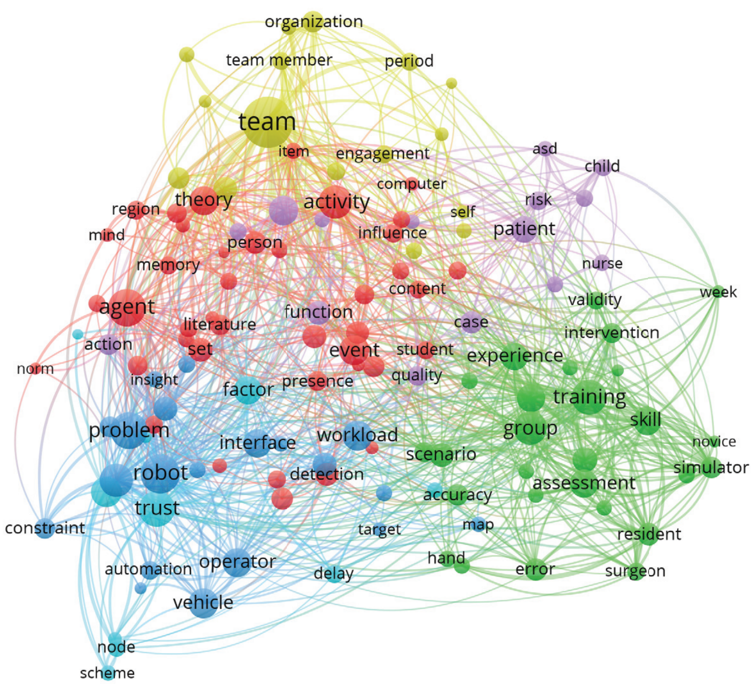


Figure 7 Map of terms related to the cluster 'Neuroscience'. The colors were used for highlighting similar terms.

This cluster covers research to understand human behavior based on the direct analysis of cerebral activity. In this context, one important theme is *brain imaging*, whose ultimate objective is to study the physical response of neurons given some psychological state. Thus, emotions (anger, fear, etc.), social cognition (the self), perceptions (visual, sounds, etc.) and non-social cognition (memory, attention, etc.) could be associated with a set of activated neurons that form a neural network.

Barrett and Satpute (2013, p. 368) explain the transition in human neuroscience "away from the search for domain-specific neural modules towards the discovery of large-scale, domain general networks that are distributed in both their structure and function." Thus, emotions, social cognition and non-social cognition can be thought of, and represented by brain imaging as, mental events "that are constructed from interactions within and between these networks that compute domain-general functions" (BARRETT; SATPUTE, 2013, p. 361).

The applications of *brain imaging c*an be seen in the work of Ayaz *et al*. (2012), in which they analyzed mental workload in complex activities using functional near infrared (fNIR).[10] They found that fNIR is useful to measure changes in mental workload through the analysis of cerebral oxygenation. Cole, Pathak and Schneider (2010) used another technique, fMRI,[11] to identify the brain's most globally connected regions.

Another theme present in the cluster is the interaction between human and machine as a team to accomplish complex operations. Chen, Barnes, and Harper-Sciarini (2011) discussed human performance issues in the supervisory controls of unmanned vehicles concerning the following factors: operator multitasking performance, trust in automation, situation awareness, and operator workload. Hancock *et al*. (2011) presented a meta-analysis concerning specifically the aspect of trust in human-robot interaction. Another set of works (LUM *et al*., 2009; VAGVOLGYI *et al*., 2009; GARCIA *et al*., 2010; SMITH; PATEL; SATAVA, 2014) is related to robotic surgery.

10 As stated by Ayaz *et al*. (2012, p. 36), "functional near infrared (fNIR) spectroscopy is a field-deployable non-invasive optical brain monitoring technology that provides a measure of cerebral hemodynamics within the prefrontal cortex in response to sensory, motor, or cognitive activation."

11 Functional Magnetic Resonance Imaging

## Discussion

Our study aimed to outline the research areas funded by the US NSS with respect to social forecasting using a combination of bibliometric research and literature review. Our discussion about these research areas will center around two themes: a) the relationship between the policy making and intelligence doctrine on the one side and the scientific production on the other side, and b) the implications of our findings for the education of police officers to make use of emerging techniques and knowledge areas identified in our work.

## The link between policy and research

In accordance with the explanation that will be given in this section, literature review shows that research promoted by the US NSS is compatible with the intelligence doctrine and governmental initiatives to promote knowledge creation in the area of human behavior.

Following the terrorist attacks of 09/11, the US intelligence community elaborated the *100 Day Plan* with the aim of delineate specific initiatives and tasks to be accomplished according to the priorities of the Director of National Intelligence. Among the United States Intelligence Community (2007), these initiatives were the creation of IARPA, an intelligence agency that would emulate the DARPA[12] operation. IARPA was conceived in the context of an initiative to "create a robust advanced research capability, emphasizing speed, surprise, and synergy." One of the research avenues of IARPA is *anticipatory intelligence*, which "focuses on characterizing and reducing uncertainty by providing decision makers with timely and accurate forecasts of significant global events" in order to develop "revolutionary concepts that may deliver real-time indications and warning, in context, to support rapid, nuanced understanding by intelligence consumers" (OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE – IARPA, 2016, online).

Besides these organizational measures, we noted initiatives

12 Defense Advanced Research Projects Agency

of the defense and intelligence agencies to get closer to the academic community that help to translate the needs of the intelligence community for the scientific community. For instance, the Director of National Intelligence asked the National Academies of Sciences, Engineering, and Medicine to establish a committee with the aim of analyzing evidence about the advance of social and behavioral sciences, which could offer new analytic tools, as well as generate new threats to the US national security (NATIONAL RESEARCH COUNCIL, 2011). Furthermore, in a workshop hosted by the National Academies of Sciences, the intelligence needs of the National Geospatial-Intelligence Agency were discussed. Amongst the research areas identified there, we highlight the area of *Human terrain*, which is defined as "the creation of operational technologies that allow modeling, representation, simulation, and anticipation of behaviors and activities of both individuals and the social networks to which they belong, based on societal, cultural, religious, tribal, historical, and linguistic knowledge; local economy and infrastructure; and knowledge about evolving threats" and *Participatory sensing*, which "tasks everyday mobile devices, such as cellular phones, to form interactive, salable sensor networks that enable the public and professionals to gather, analyze, share, and visualize local knowledge and observations. Related terms include volunteered geographic information and community remote sensing" (NATIONAL RESEARCH COUNCIL, 2010, p. 2). Compatible with the discussed concepts in these meetings, we identified the research area of Social networks. Thus, papers about geographic information (GOODCHILD; GLENNON, 2010) and migration patterns (ARENAS *et al*., 2011; SIMINI *et al*., 2012) fit with the concept of *Human terrain*; mapping the human mobility based on mobile-phone metadata (SONG *et al*., 2010a; DEVILLE *et al*., 2014) combined with the concept of *Participatory sensing*.

Furthermore, the conception of intelligence analysis in the US is heavily focused on analytic products of a predictive nature. Kent (1966, 1994) argued that the ultimate intelligence product focuses on estimating future developments. In an emphatic way, Clark (2006) stated that describing the past is not intelligence, it is history. The results presented in this paper align with this perspective about the role of intelligence analysis as a predictive approach.

The question of cognitive biases in intelligence analyses in the US is a frequent concern. It is not uncommon to discover, after some intelligence disaster, that the analysts discard relevant information because it did not fit their prevalent mindset. In 1999, the book *Psychology of intelligence analysis* was published by the Central Intelligence Agency (HEUER JR, 1999), which assess intelligence analysis as a mental process. The research of *Human reasoning,* identified in this paper, shows the uptake of this perspective, since it comprises papers about several aspects of human reasoning.

Related to the area of human reasoning is research about neuroscience. The approach is in line with the "new neuroscience" discussed in a summit organized by The National Academies of Sciences, Engineering, Medicine in 2016 with support of the US Director of National Intelligence. According to one of the participants, the new neuroscience "describes the neural function from molecules and cells up through the various parts of cognition that impact the behavior of individuals and of composite groups of people", assuming that "the brain houses its own deep templates of the world" (NATIONAL ACADEMIES OF SCIENCES, ENGINEERING; MEDICINE, 2017, p. 17–18). Together these emerging research areas suggest that efforts are made to better understand human cognitive processes in intelligence analysis and their consequences.

Finally, we noted that the US NSS promoted different approaches to understand the human behavior. While *Social networks* presents research to understand human behavior through analysis of external traits of human activity, such as the register of information gathering on the Internet, *Neuroscience* studies human behavior analyzing brain activity directly.

## Implementation of new techniques in southern security forces

The bibliographic analysis shows a variety of research areas emphasized by the US NSS that, given local conditions, could be incorporated into the work of other security forces.

However, some factors could impair proper implementation of some techniques in the Brazilian context and should be taken into consideration by managers and policy makers in this context.

The first factor to be considered is related to the innovation process and amount of resource spending in defense-related research. Comparing high income countries, Mowery (2012) shows that, from 1981 until 2010, the United States has the highest defense R&D share within central-government R&D spending. In order to offer a perspective with southern countries, where available, table 1 shows recent data related to government budg*et al*locations for defense R&D (OECD, 2020). In the table we can see that the order of magnitude of the US spending is much higher than the one in Latin American countries.[13]

**Table 1**: Government budg*et al*locations for defense R&D

| Country | Government budg*et al*locations for defense R&D (2017)* |
|---|---|
| **Chile** | **0.199** |
| **Colombia** | **9.259** |
| **Mexico** | **8.487** |
| **United States** | **53.858.425** |

* Values in Million US Dollars with 2015 as the reference year.

Thus, the difference related to the amount of resources invested translates into the creation of innovation ecosystems where both the defense and security organizations, together with universities and researchers, build knowledge and technologies for use of the general society and for security applications. This logic was created along the cold war conflict (ROSENBERG; NELSON, 1994). However, as shown in Maciel, Bayerl and Kerr Pinheiro (2019), it still persists nowadays.

13 There is no data available about Defense R&D allocations related to Brazil. However, given that the magnitude of defense spending is compatible with those of Latin American, we speculate that the numbers would not be too different from those presented for Chile, Colombia, and Mexico.

Another important factor, which impairs the development and absorption of new information technologies by the southern security forces, is related to the expectations and demands of information by policy makers and managers. In our understanding, the role of police forces very narrowly focuses on 'arresting people' to the detriment of understanding more complex dynamics of criminal trends or causes. Therefore, the activity can afford tools of lower technological complexity.

The root of this phenomenon likely stems from the cold war logic and the dictatorships, which followed in the 1960s, where the strategic intelligence and analysis about how the world worked was provided by the United States intelligence, while the role of Latin America's national intelligence services was only to monitor the regimes' dissidents (ANTUNES, 2001). Since the proximity of police forces with defense agencies largely continued, this logic persisted after democratization, which occurred in 1980s. Even though the targets were not the regime dissidents anymore, the activities still remained very focused on the role of tactical activities.

Although it is a worldwide tendency that most resources of the intelligence services are devoted to tactical intelligence (CLARK, 2006), we suggest that, in the Brazilian context, both the role of the intelligence services and security forces are too narrowly focused on tactical issues. That is due to expectation of policy makers, who constrain the behavior of security professionals. Since tactical activities do not demand technological complexity, R&D of novel technologies are not justified.

The creation of an innovation ecosystem is a long-term project, which depends on several innovation policies in order to strengthen the relationship between security forces and universities. Besides these long-term actions, we delineate below an individual-focused approach that could be implemented by Brazilian security and police forces in order to absorb the formal knowledge produced by the US NSS and described in this work.

First of all, it is important to acknowledge that the intelligence analyst is foremost a social scientist. The idea is not new, since this was already recognized by Sherman Kent (1966) in the spring of the US Intelligence analysis as an important activity inside the intelligence apparatus. However, we emphasize this factor given the current availability of massive datasets for the general public, and therefore, the exponential growth of tools for processing and analyzing data created outside the walls of police forces.

Thus, an important factor is the training of security agents in basic statistics and mathematics in order to provide sufficient literacy in the techniques created elsewhere. The basic literacy could equip security personnel with the necessary knowledge about the pros and cons of each technique and their mathematical or statistics assumptions. This would not only enhance capabilities of law enforcement agencies, but also help safeguarding against (unwitting) biases and mistakes in the analysis of data.

Advancing staff knowledge is also important for the procurement phase. Ideally, security agencies should not rely on off-the-shelf solutions embedded in software without a critical analysis of their necessities and the level of training of their agents. This is because algorithms incorporate premises and assumptions that depend on the type of data or the analytical problem at hand and influence the way data is analyzed and results can (or should) be interpreted. For instance, in network analysis there can be no optimal algorithm for all possible community detection tasks, mainly because the concept of community in a network is defined on theoretical grounds (PEEL; LARREMORE; CLAUSET, 2017). Consequentially, because of the vast variety of vendors and analytically tools available for business and security and intelligence agencies, it is important to know the working mechanisms embodied in the software. Otherwise, we could simply be substituting our own mental processes and biases with those of the algorithm creator.

To sum up, in order to incorporate scientific knowledge into organizational repository, it is important to consider that the transfer of explicit to tacit knowledge is not automatic (CHOO, 2003; NONAKA; TAKEUCHI, 2008). Thus, formal knowledge embodied in the scientific articles might be linked with contextual knowledge already in the mind of the professionals.

## Conclusion

In this article, using a science mapping approach, we created a map of the research fronts within the paradigm of social forecasting funded by security and intelligence agencies of the United States. We clustered these research fronts into five meaningful research areas and create a term-map in order to carry out a literature review. We identified five main research areas within the paradigm of social forecasting: a) Complex networks, b) Social Networks, c) Human reasoning, d) Optimization algorithms, and e) Neuroscience.

Despite our meaningful findings about the technological content of the *Social forecasting* paradigm, this study is not free from limitations. First, the relationship between the decision-making and the scientific output was considered from an exemplificative perspective and requires a more meticulously analysis in a subsequent work. Besides that, while a sample selection based on the most frequently cited papers gives a good illustration of the consolidated knowledge, it hinders the observation of more recent articles, which could have been forming the forefront of a new set of relevant technologies and applications.

Furthermore, other relevant topics for the society in general, such as privacy, which are present in the corpus but do not receive a great amount of citations, were not discussed either and deserve additional consideration. This is important to highlight, due to the ease of use of these technologies to mass surveillance and civil control, which could compromise the freedom of opinions in the political arena. Even though we consider these tools mainly from a technical perspective, we are conscious that this dark side is a real problem that needs be taken seriously.

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# Previsão Social: Uma Revisão de Literatura da Pesquisa Promovida pelo Sistema Nacional de Segurança dos Estados Unidos para Modelar o Comportamento Humano

## Resumo

O desenvolvimento de novas tecnologias de informação e comunicação aumentou o volume de fluxos informação na sociedade. Para as forças de segurança, esse fenômeno apresenta novas oportunidades para coleta, processamento e análise de informação associado com a oportunidade para coletar uma grande e diversa quantidade de dados. Ao mesmo tempo, são necessárias novas competências organizacionais e individuais para lidar com tal fenômeno. Nosso estudo teve como objetivo delinear as áreas de pesquisa financiadas pelas agências de defesa e inteligência relacionadas à previsão social. Baseado em técnicas bibliométricas, agrupamos 2688 artigos financiados pelas agências de defesa ou inteligência in cinco áreas de pesquisa: a) Redes complexas; b) Redes Sociais; c) Raciocínio humano; d) Algoritmos de otimização; e e) Neurociência. Em seguida, analisamos qualitativamente os artigos mais citados em cada área. Nossa análise identificou que as áreas de pesquisa são compatíveis com a doutrina de inteligência dos Estados Unidos. Além disso, nós consideramos que as áreas de pesquisa poderiam ser incorporadas nas atividades das forças de segurança, desde que treinamento básico em técnicas quantitativas de pesquisa seja oferecido. Tal treinamento básico não apenas aprimoraria as capacidades das forças de segurança como também ajudariam em salvaguardar contra (involuntários) vieses e erros na análise de dados.

**Palavras-chaves:** Análise de inteligência; comportamento humano; rede social; rede complexa; teoria dos jogos.

# Previsión social: Una revisión de la literatura de la investigación promovida por el Sistema de Seguridad Nacional de los Estados Unidos para modelar el comportamiento humano


## *Resumen*

El desarrollo de nuevas tecnologías de la información y la comunicación ha aumentado el volumen de los flujos de información en la sociedad. Para las fuerzas de seguridad, este fenómeno presenta nuevas oportunidades para recolectar, procesar y analizar información asociada a la oportunidad de recolectar una gran y diversa cantidad de datos. Al mismo tiempo, se necesitan nuevas habilidades organizativas e individuales para hacer frente a este fenómeno. Nuestro estudio tuvo como objetivo delinear las áreas de investigación financiadas por agencias de defensa e inteligencia relacionadas con la previsión social.

Basados en técnicas bibliométricas, hemos agrupado 2688 artículos financiados por agencias de defensa o de inteligencia en cinco áreas de investigación: a) Redes complejas; b) Redes sociales; c) Razonamiento humano; d) algoritmos de optimización; y e) neurociencia.

Luego, analizamos cualitativamente los artículos más citados en cada área.

Nuestro análisis identificó que las áreas de investigación son compatibles con la doctrina de inteligencia de los Estados Unidos. Además, creemos que las áreas de investigación podrían incorporarse a las actividades de las fuerzas de seguridad, siempre que se ofrezca una formación básica en técnicas de investigación cuantitativa. Esta formación básica no solo mejoraría las capacidades de las fuerzas de seguridad, sino que también ayudaría a protegerse contra sesgos y errores (involuntarios) en el análisis de datos.


**Palabras claves:** Análisis de inteligencia; comportamiento humano; red social; red compleja; teoría de los juegos.

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