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[How] Can Pluralist Approaches to Computational Cognitive Modeling of Human Needs and Values Save our Democracies?

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ABSTRACT. In our increasingly digital societies, many companies have business models that perceive users' (or customers') personal data as a siloed resource, owned and controlled by the data controller rather than the data subjects. Collecting and processing such a massive amount of personal data could have many negative technical, social and economic consequences, including invading people's privacy and autonomy. As a result, regulations such as the European General Data Protection Regulation (GDPR) have tried to take steps towards a better implementation of the right to digital privacy. This paper proposes that such legal acts should be accompanied by the development of complementary technical solutions such as Cognitive Personal Assistant Systems to support people to effectively manage their personal data processing on the Internet. Considering the importance and sensitivity of personal data processing, such assistant systems should not only consider their owner's needs and values, but also be transparent, accountable and controllable. Pluralist approaches in computational cognitive modelling of human needs and values which are not bound to traditional paradigmatic borders such as cognitivism, connectionism, or enactivism, we argue, can create a balance between practicality and usefulness, on the one hand, and transparency, accountability, and controllability, on the other, while supporting and empowering humans in the digital world. Considering the threat to digital privacy as significant to contemporary democracies, the future implementation of such pluralist models could contribute to power-balance, fairness and inclusion in our societies.

Keywords: Privacy, pluralism, transparency, accountability, controllability, computational cognitive modeling, cognitive personal assistant systems, needs, values, enactivism, cognitivism, credictive processing, GDPR.

RÉSUMÉ. [Comment] Est-ce que les approches pluralistes à la modélisation cognitive computationnelle des besoins et valeurs humains peuvent sauver nos démocraties ? Dans nos sociétés de plus en plus digitales, un grand nombre des entreprises implémentent un modèle commercial qui perçoive les données personnelles des usagers (ou des consommateurs) en tant que ressource cloisonnée, détenue et contrôlée par le contrôleur des données plutôt que les personnes concernées. La collecte et le traitement d'une telle quantité de données personnelles comporte de nombreuses conséquences techniques, sociales et économiques négatives, y compris l'atteinte à la vie privée des personnes et à l'autonomie des individus. En conséquence, de nouvelles réglementations telles que le règlement

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général européen sur la protection des données (RGPD) ont tenté de prendre des mesures importantes pour une meilleure mise en œuvre du droit à la vie privée digitale. Le présent document propose que ces actes juridiques s'accompagnent du développement de solutions techniques complémentaires telles que les systèmes d'assistants personnels cognitifs qui pourraient aider les personnes à gérer le traitement de leurs données personnelles sur Internet. Considérant l'importance et la sensibilité du traitement des données à caractère personnel, ces systèmes assistants devraient non seulement tenir compte des besoins et des valeurs de leurs propriétaires, mais aussi être transparents, responsables et contrôlables. Les approches pluralistes dans la modélisation cognitive computationnelle des besoins et des valeurs humaines qui ne sont pas limitées par des frontières paradigmatiques traditionnelles comme le cognitivisme, le connectionnisme ou l'énactivisme, pourraient créer un équilibre entre l'aspect pratique et l'utilité, d'une part, et la transparence, la responsabilité et le contrôle, d'autre part, tout en appuyant et en donnant du pouvoir aux humains dans le monde digital. En considérant la menace pour la vie privée digitale comme une menace significative pour les démocraties contemporaines, la mise en œuvre future de tels modèles pluralistes contribuerait à l'équilibre des pouvoirs, l'équité et l'inclusion dans nos sociétés.

Mots-clés : Vie privée, pluralisme, transparence, responsabilité, contrôlabilité, la modélisation cognitive computationnelle, l'assistant cognitive personnel, les besoins, les valeurs, énactivisme, cognitivisme, le traitement prédictif, RGPD: règlement général sur la protection des données.

1 – INTRODUCTION

In today's hyper-connected, increasingly digital society, more data is being collected, processed and transferred than ever before. Individuals' daily activities result in a dense "data exhaust" stream that reflects almost all interactions and transactions (data generated when browsing the web, electronically conducting financial transactions, engaging in online social interactions, etc.). Additionally, the behavior of individuals is increasingly tracked in a ubiquitous manner (location, health tracking, data generated by embedded sensors, IoT devices etc.). The economic impact of the resulting wealth of personal information, *i.e.*, "information relating to an identified or identifiable individual (data subject)" (OECD, 2013a), is highly context-dependent and difficult to quantify (OECD, 2013b). However, personal data clearly does open up opportunities for organizations to better understand their customers' needs and preferences, improve and tailor products, communicate more effectively, and create innovative applications that transform data into valuable services. Data in general, and personal data in particular, has therefore become an important driver of innovation and economic growth (Zhang, 2017) and given rise to the notion of an information, data, or digital economy.

The ever-increasing collection of information about individuals raises serious concerns though. Since the business models concentrate on lock-in effects and exploitation of personal data, the different implications, not only on individuals' privacy (see *e.g.* Chaudhry *et al.*, 2015), but also on social and economic spheres are multifaceted:

- From a *societal perspective*, privacy can be considered a basic requirement for enabling citizens' agency and freedom (Rössler, 2001). Cases such as the "Facebook-Cambridge Analytica data scandal" (Cadwalladr, 2017)

clearly show how dramatically our democracies could be threatened if personal data processing would not be practiced in a value-based manner. Moreover, while many data controllers – *i.e.* some of the public authorities and companies – have access to computational infrastructure, including software and servers, to collect and manage data about their users and their consent decisions, users have not yet been appropriately empowered by personal privacy management tools on the client-side. It is unwarranted to expect users to be able to actively manage their privacy (*e.g.* their consents) in their limited time and with their limited cognitive capacities (*e.g.* limited memory), and their limited professional training in privacy law without supporting tools. This matter of injustice can be well captured by Walzer's (1983) notions of spheres of justice and complex equality. According to Walzer, societies consist of several spheres, and inequality in one of these spheres should not invade another. Regarding the current practice of gaining consent on the Internet, the inequality between the data processing power of corporations, on the one hand, and limited time and professional training of the data subjects, on the other, should not invade the users'right to privacy, which belongs to another social sphere, *i.e.*, the personal sphere.

- From an *economic perspective*, many issues caused by the current practice of personal data processing have been discussed in the literature (see *e.g.* Moore & Tambini, 2018). Among others, the current practice of personal data processing sometimes produces business models, which attempt to develop the capacity to influence users' mindsets, needs, values, decisions, or behaviors based on the collected personal data about the users. In other words, while personal data can be used to target end-users' needs or to improve the service quality, in some cases companies employ user profiles constructed based on collected personal data for manipulation of users' behavior instead of bettering the quality of services or products (Bujlow, Carela-Español, Solé-Pareta, & Barlet-Ros, 2017). This motivates some of the companies to perceive people's private personal data as a siloed and tradable source of economic benefit (Zuboff, 2019). Due to this, smaller entities (such as start-ups) have little access to people's personal data which hinders their ability to compete with bigger (mainly US-based) companies who dominate personal data markets. This results in the monopoly of big players who do not necessarily provide better services for their customers or consider ecological or human values in their business models.

After a short reflection on some of the existing legal and technical responses to the above described issues, we argue in the following that the development of Cognitive Personal Assistant Systems should be considered as one of the necessary mechanisms to save our societies from the vast threatening implications caused by the invasion of users' privacy and autonomy on the Internet. Moreover, we propose that pluralist approaches in computational cognitive modeling of human needs and values seem to be an appropriate approach for the development of Cognitive Personal Assistant Systems that are not only useful and practical but also transparent, accountable and controllable.

2 – THE NEED FOR COGNITIVE PERSONNAL ASSISTANT SYTEMS

Considering the socioeconomic and sociotechnical challenges and issues caused by the current practice of data processing on the Internet, which were briefly summarized in the previous section and have been extensively reported in the literature, different mechanisms and approaches have been proposed for resolving these issues:

- From a *legal perspective*, according to different legal frameworks for personal data processing, such as the European General Data Protection Regulation (GDPR), personal data processing can be considered as *lawful* under different circumstances laid out in regulations (see *e.g.* the Article 6 of the GDPR). In general, data controllers are responsible for ensuring a *lawful* practice of personal data processing. Based on such legal frameworks, users can apply their rights by giving or withdrawing their consents to the processing of their personal data for one or more specific purposes. However, as it was discussed before making consent-decisions, keeping track of the list of all given consents (which is a prerequisite for withdrawing or modifying the given consents), and managing the given consents is not an easy task for all users. Therefore users need complementary supporting mechanisms to be able to practice their rights properly.

- From a *technical perspective,* while calls for development of privacy enhancement technologies (see *e.g.* Article 29 Data Protection Working Party, 2000) or privacy by design approaches (see *e.g.* Cavoukian, 2009) are not new, in the recent years, a shift in implementation of personal data ecosystems has been proposed by different researchers using different names, such as User-centric Personal Data Ecosystems (*e.g.* Moiso & Minerva, 2012), Personal vaults (*e.g.* Mun *et al.*, 2014) and Personal Databoxes (*e.g.* Chaudhry *et al.*, 2015). While these concepts and their technical implementation are not exactly the same, they all refer to a set of similar technologies that try to empower people by providing tools and the infrastructure required for a self-determined control of personal data. Besides these Personal-Data-Store (PDS) based architectures, another proposed technical approach is encryption-based architectures (see *e.g.* Wang, Mickens, Zeldovich, & Vaikuntanathan, 2016), in which data is stored with untrusted third parties (on servers of companies or non-personal cloud servers) but can only be managed *via* access control of the data owners (*i.e.* the users). The PDS-based and encryption-based approaches are not mutually exclusive but can be combined.

While legal frameworks such as GDPR or the novel technical architectures such as PDS-based or encryption-based architectures can be considered as important steps for improving the digital privacy of the data subjects, we believe that without implementation of further complementary solutions, these approaches do not provide an ultimate resolution of existing issues. The main reason for this is that *informed consent* (besides other circumstances laid out in regulations) can be used in these approaches for justification of *lawfulness* of personal data processing. However, there are numerous difficulties with the informed consent-based approaches to privacy, from the ability of users to understand the context and relevance of the consent-decisions they are making, or the ability of the users to remember all of their consent decisions, to the ability of users to map such decisions across a wide variety of different

technical systems (Human & Wagner, 2018). Moreover, the current practice of obtaining informed consent on the Internet, is a very time-demanding process that expects users to read and understand very long and complex information in the Terms of Service (TOS) and Privacy Policies (PP). While GDPR and the described PDS-based and encryption-based technical approaches aim to empower users by giving them the power of controlling their data, these approaches do not tackle the existing difficulties regarding gaining or managing informed-consents at their core. On the contrary, users might even face more risks, mainly due to lack of expertise, limited cognitive abilities (such as memory) or time to manage their own personal data. As a result, if these approaches would not be equipped with advanced supporting systems, their implementation would itself cause serious challenges and privacy issues for users. Such supporting systems should be able to help users to manage their data-access, data-sharing, and data-processing policies over time and in different contexts. Considering this, we propose that the development of Cognitive Personal Assistant Systems present a crucial necessity of our digital world in order to support users to manage their personal data processing on the Internet.

3 – TOWARDS THE DEVELOPMENT OF COGNITIVE PERSONNAL ASSISTANT SYSTEMS

Without applying another complementary mechanism, two issues of the existing personal data ecosystems (among others) are not easily tackled by the existing legal and technical frameworks:

1. Solely user-oriented consent and access-control management: While users should have the right to control their personal data processing, including their consents, research shows that in most cases, people are not aware of the real consequences of their consent decisions or even do not read what they are consenting to (Obar & Oeldorf-Hirsch, 2018). Therefore, considering the limited time, expertise, memory and cognitive capacities of humans, expecting users to be solely responsible for managing and keeping track of their consent decisions does not seem valid.

2. External personalized services: Currently, most of the services on the Internet that need personalization are provided by external service providers. This requires that the external service providers collect data of and about their users in order to be able to provide personalized services. Even if all that would be done based on GDPR (or similar legal frameworks) and based on the users' explicit consents, the downside of this practice–in some cases–could be the misuse of the collected data for *lawful* manipulation of the users'behavior based on inferred user profiles. A threatening example for this is the application of profiling mechanisms and digital direct marketing in election campaigns.

Considering the above characteristics, we propose that two types of personal systems, designed to function under the control of the data subjects should be developed to tackle the existing individual, technical and socioeconomic issues of personal data processing on the Internet: *1. Personal Consent Management Systems*, which are systems that support users to make, manage, and keep track of their consent-related and access control-related

decisions throughout their digital interactions. *2. Personal Personalization Systems*, which are systems that provide personalized services for users, but are owned and controlled by users themselves, instead of external service providers. We call a system a *Cognitive Personal Assistant System,* if the system provides the services of any or both of these two systems in a personalized and context-sensitive manner, as well as based on the users' individual and situated needs and values. Such systems should not only be useful and practical, but also transparent, accountable, and most importantly controllable.

The management of consent-related decisions and provisions of personalized services expected from Cognitive Personal Assistant Systems are highly context-sensitive and depend on the situated needs and values of the specific user. Therefore, a first step towards the realization of Cognitive Personal Assistant Systems would be the development of applicable computational cognitive models of human need satisfaction and value fulfillment. However, development of such computational cognitive models for a *domain-general* real-world information system does not seem to be an easy task. To make this point clear, we shortly reflect on the potential approaches towards development of computational cognitive models of human needs, based on the classical paradigms of cognitive science, *i.e.* cognitivism, connectionism, and enactivism. We propose, in a domain-general setup, none of these approaches alone could realize a satisfactory balance between transparency, accountability, controllability, on the one hand, and usefulness and practicality on the other hand, considering the existing level of scientific and technological advancements.

While we dedicate our discussion to computational cognitive models of need satisfaction, almost the same difficulties hold for the development of computational cognitive models of value-fulfillment. Although, it is hard to imagine an *accountable* real-world system that does not consider both needs and values together, our simplified discussion on computational cognitive modeling of human need satisfaction should be enough to show the difficulties ahead.

3.1 - Cognitivist approach towards developing computational cognitive models of human needs

Cognitivism is a paradigm in cognitive science which attempts to understand cognition and intelligence in terms of processing of explicit internal representations (Mandler, 2002; Ward, Silverman, & Villalobos, 2017). Normally, *cognitivist* computational models, which use explicit representations, are constructed based on specific – mainly psychological – background theories. As a consequence, one of the starting points for the development of cognitivist models is to choose the theoretical framework of the model.

From a cognitivist perspective, many of the published theories that can be labeled as *need theories,* have proposed different categorizations of human needs. Table 1 summarizes some of the most famous categorizations of human needs. Since these categorizations can be considered as an attempt for providing *explicit representations* of human needs, they can also be interpreted

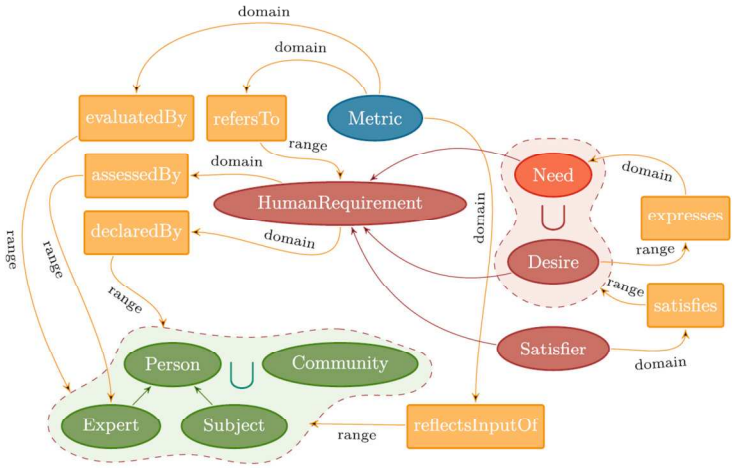
as *cognitivist* categorizations of human needs. While many competing theories on human *needs* exist (see *e.g.* Table 1), choosing one single theory – as the background theory of a *domain-general* cognitivist computational model – to cover all sophisticated and multidimensional aspects of human need satisfaction seems to be impossible. This point becomes clearer, if we consider that even no consistent usage of the term *need* can be found across or within disciplines (see *e.g.* Gasper, 2007). This makes a scientific comparison between different *need theories* almost inconceivable.

Does this mean that these categorizations are useless for cognitivist computational models? Our answer is *No*! Since cognitivist approaches are based on explicit representations, the need categorizations can be used to design computational *ontologies* which are required to underlying representation-frameworks of cognitivist models. Therefore, the main question here is: *Which categorization should be applied for the construction of cognitivist ontologies representing human needs?* Considering that each of these categories are based on specific assumptions and standpoints, they can be useful in different contexts of application. This is why, we propose that a *pluralist* approach for the development of domain-general systems, such as Personal Cognitive Assistant Systems, should be applied. Such an approach could not only prevent the dominance of one single categorization, but also expand the areas of application of the developed models.

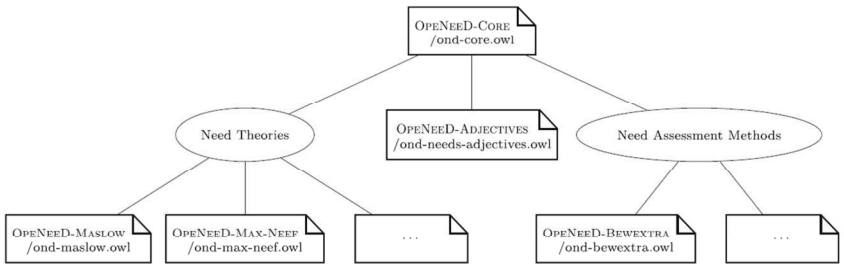
Author	Concise summary/Categorization
Aristotle (Reader, 2005)	Necessity is closely related to needs. Two types of necessities or needs: 1. Absolute needs, 2. Relative needs. Three types of goods: 1. Goods of the soul, 2. Goods of the body, 3. External goods
Murray (1938)	Psychogenic needs: 1. Ambition needs, 2. Materialistic needs, 3. Power needs, 4. Status defense needs, 5. Affection needs, 6. Information needs
Alderfer (1972)	1. Growth, 2. Relatedness, 3. Existence
Kano *et al.* (1984)	1. Basic needs, 2. Delights, 3. Performance needs
Deci and Ryan (1985)	Psychological needs: 1. Competence, 2. Relatedness, 3. Autonomy
Maslow (1943; 1970)	1. Physiological needs, 2. Safety needs, 3. Love needs, 4. Esteem needs, 5. Cognitive needs, 6. Aesthetic needs, 7. Self-actualization, 8. Self-transcendence
Max-Neef (1992)	A 36 cell matrix of needs; First dimension: 1. Subsistence, 2. Protection, 3. Affection, 4. Understanding, 5 Participation, 6. Leisure, 7. Creation, 8. Identity, 9. Freedom; Second dimension (existential categories): 1. Being (qualities), 2. Having (things), 3. Doing (actions), 4. Interacting (settings)

Doyal & Gough (1991)	1. Health needs, 2. Intermediate needs, 3. Autonomous needs
Price (1994)	Children Needs: 1. Physical, 2. Physiological, 3. Psychological, 4. Social, 5. Emotional, 6. Intellectual, 7. Educational, 8. Spiritual
Glasser (1999)	1. Survival (food, clothing, shelter, breathing, personal safety, security and sex, having children), 2. Belonging/connecting/love, 3. Power/significance/competence, 4. Freedom/autonomy, 5. Fun/learning
Thomson (2005)	Fundamental *vs* instrumental needs
McLeod (2011)	Absolute *vs* relative needs; Universal *vs* particular needs; Existence *vs* welfare needs

Table 1
Some of the categorizations\ of human needs based on a cognitivist interpretation of different need theories (Human *et al.*, 2017)



(a)



(b)

Figure 1
(a) OpeNeed-CORE ontology
(b) OpeNeed Ontology family (Human *et al.*, 2017)

Figure 1 shows OpeNeed as an example of pluralist approaches in the development of ontologies for representing human needs (Human, Fahrenbach, Kragulj & Savenkov, 2017). OpeNeed has a light-weight and robust *Core Ontology* (Figure 1-a) which only includes a limited set of optional classes and properties that are common among need theories. Since none of the elements of *OpeNeed-CORE* are obligatory, models that would use OpeNeed could be designed based on the interpretations and standpoints of their developers, rather than based on a strictly defined ontology. The main element of the *OpeNeed-CORE* ontology is the *Need* class. As shown in Figure 1-b, since OpeNeed follows a pluralist standpoint, the technical definition of needs (or other elements of the *OpeNeed-CORE* ontology) could be specified by using a set of other extendable ontologies that represent different need categorizations, *e.g.* Maslow's or Max-Neef's categorizations.

Based on a pluralist approach to *cognitivist* computational modeling of human needs, different modules of a single system, which work based on OpeNeed, could use different need ontologies. However, if different modules would use different ontologies, *what can be done to make collaboration between different modules possible?* This is a valid concern. In some cases, it could be necessary to semantically link the data that is represented by different ontologies in different modules. Standard methods in the Semantic Web can be used to link similar entities or entities that have a well-defined logical relation. From a pluralist perspective however, it is very important to also have mechanisms to represent the different types of *[epistemic] disagreements* that could exist either between different ontologies themselves or between the data that is represented by them. One way to fulfil this pluralist commitment is to use ontologies such as Polyphony (Figure 2) as a complementary ontology to represent potential epistemic disagreements between different entities. Thereby, *knowledge engineers* would not always try to *resolve* the *conflicts* between the different entities and would have a technical tool to respect the fact that disagreements are inseparable characteristics of our scientific discourse.

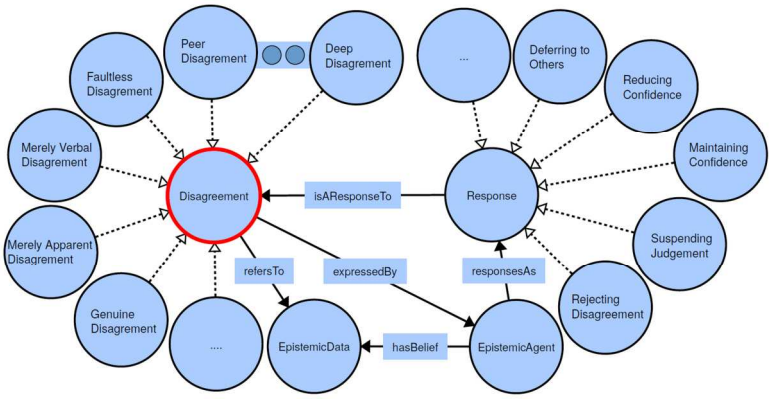


Figure 2
Core concepts of Polyphony, an ontology for representing epistemic disagreements (Human, Bidabadi, & Savenkov, 2018)

So far, we have advocated the application of pluralist approaches in the development of ontologies for representing the required underlying digital artifacts of *cognitivist* computational models, which could be used in Cognitive Personal Assistant Systems. It needs to be emphasized that OpeNeed or Polyphony are just two examples of such ontologies. Based on the application cases, many different ontologies should be developed. Since each of such ontologies would be based on specific and limited assumptions, modules created based on such ontologies would normally have limited application domains. It is highly probable that such modules could be useful and practical in their own domain. Moreover, because such *cognitivist* models apply explicit representations, they would normally have a high-level of transparency and controllability. However, since cognitivist approaches are usually developed based on an algorithmic approach, they are often less applicable in the domains that include inputs that are hard to be predicted by the designers of the algorithms. Considering that 1) dealing with surprising situations or unpredicted users' behaviors (or needs) are common in real-world applications, and 2) in an ideal future, the application domain of the Cognitive Personal Assistant Systems should not be limited to specific predictable domains, we propose, *cognitivist* approaches – even *pluralist cognitivist approaches* – should be combined with other more adaptable non-cognitivist approaches of computational cognitive modeling, if we aim to develop domain-general Cognitive Personal Assistant systems.

3.2 - Non-cognitivist approaches towards developing computational cognitive models of human need satisfaction

Context-dependency and individual heterogeneities are two important aspects of the cognitive mechanism behind human needs satisfaction (Human, Bidabadi, Peschl, & Savenkov, 2018). Considering the limitations of cognitivist models in dealing with complex real-world situations and considering the recent advancements in other paradigms of cognitive science, such as *connectionism* (Fodor & Pylyshyn, 1988), which is *e.g.* reflected in successful *deep learning* systems (White, Vendome, Linares-Vásquez & Poshyvanyk, 2015), or *enactivism* (Ward *et al.*, 2017) which is *e.g.* reflected in *predictive processing* (Clark, 2013), we propose that Cognitive Personal Assistant Systems can also benefit from these approaches in computational modeling. For example, the predictive processing approach to cognition – which has been recently used for modeling of a wide range of anatomical and physiological aspects of the brain and various cognitive processes (Chater & Oaksford, 2008; Clark, 2013, 2015; Hohwy, 2013; Spratling, 2017) – could be an appropriate learning approach for the development of some of the sub-systems of Cognitive Personal Assistant Systems. Our main reason is that since Cognitive Personal Assistant Systems are expected to support users to satisfy their needs and fulfill their values, a systemic replication of learning mechanisms of our brains could be a potentially appropriate approach for development of such systems (see Human, Bidabadi, Peschl *et al.*, 2018).

While connectionist or enactivist approaches towards development of computational cognitive models of human need satisfaction could lead to the construction of more robust and adaptive systems, they normally do not have a

high level of transparency and controllability due to the lack of explicit representations in most cases. Therefore, it seems that the combination of these systems with cognitivist approaches would lead to a better balance between transparency, accountability and usefulness of the systems.

3.3 - A Pluralist Approach towards Cognitive Personal Assistant Systems

Cognitive Personal Assistant Systems should be context-sensitive, and function based on the individual needs and values of their owners. On the one hand, they would have access to a vast amount of personal data regarding their owners, which cannot be shared with any other system, on the other hand, they would not be able to use exactly the same methodologies that are applied for profiling millions of users based on *Big Data,* because of their specific type of data model. The implementation of computational cognitive models of human need satisfaction and value fulfilment is one way of realizing Cognitive Personal Assistant Systems. Considering the complexity of these models and the current state of the art in computational cognitive modeling, we propose that only a pluralist approach of development can create a balance between their transparency, accountability and controllability, on the one side, and their usefulness and practicality on the other. Moreover, we propose that a pluralist approach towards the development of Cognitive Personal Assistant Systems can be achieved by considering at least three dimensions:

1. different paradigms of cognitive science, such as cognitivism, connectionism, and enactivism;

2. different standpoints and methodologies within each paradigm;

3. the impact of human-actors in the development of computational models, *i.e.* the impact of individual researchers, designers, software-developers, groups, etc.

Based on these considerations, Figure 3 shows a basic schematic architecture of a Cognitive Personal Assistant System. The described system is modular and consists of many different sub-systems, which are designed based on various approaches of different paradigms in cognitive science. Such models can be created and implemented by multiple scientists and engineers to guarantee the reflection of different standpoints in the cognitive model.

Based on this architecture, the Cognitive Personal Assistant System consists of three main components:

1. *The Stem*, which is represented with a gear in Figure 3, is the central controlling mechanism of the system, which manages all inputs and outputs. The coordination between the two main sub-systems are managed by this system. It also manages all components that are needed for user interactions, including the settings, reports, and visualizations that are needed for making the decision process of the system transparent and understandable for users. Moreover, the stem includes the required *knowledge-based* and *intelligent* components which could make inference or provide knowledge about the world. An example of such components would be an intelligent component that could provide context-based knowledge about the regulations (*e.g.* about the GDPR).

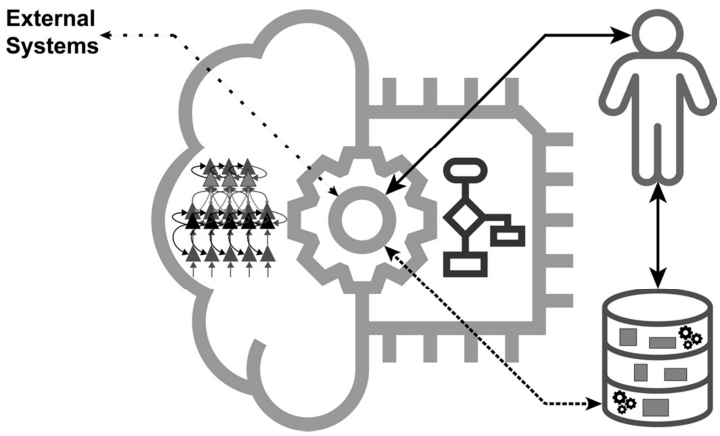


Figure 3
The basic architecture of a Cognitive Personal Assistant System

2. *The Cognitivist Personal Assistant System*, which is represented with a circuit, including a flowchart, is a rule-based and formal sub-system which uses explicit representations to function. An example of such explicit representations, in our system, could be explicit privacy decisions that are set by users. The Cognitivist Personal Assistant System could consist of many different cognitivist sub-systems, including different cognitivist models of human needs as discussed in section 3.1.

3. *The Non-cognitivist Personal Assistant System,* which is represented with a hemisphere, including a predictive processing architecture (adapted from Kanai, Komura, Shipp, & Friston, 2015), incorporates all sub-systems that apply non-cognitivist models such as deep learning, predictive processing and the like.

Above, the conceptual architecture of a Cognitive Personal Assistant System which has been designed based on a pluralist approach was presented. The next step in this research would be the implementation of different components of such system based on a concrete use-case. Open aspects such as the exact interaction mechanisms between different components, security of the system, user interfaces, APIs, etc. should be developed and evaluated based on the use-case.

4 – CONCLUSION

The current practice of personal data processing on the Internet has raised serious concerns regarding humans' privacy and autonomy. Legal frameworks such as the European GDPR and technical frameworks such as PDS-based or encryption-based architectures can be seen as important steps towards human-centric personal data ecosystems. However, even based on these frameworks, users are expected to manage and keep track of all of their own consent-related decisions. This seems to be impossible for almost all humans which have

limited time, expertise, and cognitive capacities. Moreover, based on these approaches, most of the *even lawful* personalized services are still provided by systems that are not under the actual control of the users. As a result, one of the main reasons that has caused the existing privacy and socio-economical concerns, *i.e.* informed consent-based personal data processing by external service providers, cannot be addressed by these approaches alone. In this conceptual paper, we proposed that the development of Cognitive Personal Assistant Systems which empower users in their digital lives should be considered as an important complementary approach to the existing human-centric legal and technical frameworks. Such cognitive systems would support users to manage and keep track of their consent-related and access control-related decisions. These systems could provide different personalized services to the users, while respecting and protecting their privacy and autonomy by having access to a vast amount of users' personal data, and using computational cognitive models of human need satisfaction and value fulfillment.

Considering 1) the existing scientific disagreements regarding the nature of human needs and values, 2) vast and diverse application areas of the Cognitive Personal Assistant Systems, 3) Context-sensitivity and individual heterogeneity of need satisfaction and value fulfillment in humans, and 4) the need for finding a balance between transparency, accountability, and controllability of Cognitive Personal Assistant Systems and their practicality and usefulness, we proposed that pluralist approaches towards computational cognitive modeling of human need satisfaction and value fulfillment should be applied for the development of Cognitive Personal Assistant Systems.

According to Ezrahi (2015), democracy is a specific political order which expects the creation and embodiment of correspondingly specific types of agents, procedures and institutions. If these agents, institutions, and procedures are not reasonably co-performed, the regime could not exist as a democracy. We believe that invasion of citizen's privacy and autonomy would hinder the co-performance of involved agents (*e.g.* citizens *vs.* data-controllers), or institutions *(e.g.* elections, in the case of applying profiling mechanisms and digital direct marketing in election campaigns). Therefore, as a complementary mechanism for protecting users' privacy and autonomy, we propose that the development of cognitive personal assistant systems based on pluralist perspectives, would contribute in resolving some of the most important challenges in our digital societies that are threatening our contemporary democracies.

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