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NEEDS AS MENTAL ATTITUDES. AN ONTOLOGICAL STUDY FOR PA'S SERVICE DESIGN

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Al mitico Gino Rosa

Mangia i cioccolatini, piccola;

mangia i cioccolatini!

Bada che al mondo non c'è altra metafisica che la

cioccolata.

(Fernando Pessoa, *Tabaccheria*)

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Fernando Pessoa suggests that, in a way, the metaphysics of chocolate is the only real philosophical question. And who can blame him? Savoring the concreteness of experience, as happens with chocolate, seems to be the desirable goal of all investigations. Having reached the end of a course of study full of difficulties and surprises, I want to thank all the people that I met along the way, people that have contributed to making the experience of this work concrete like the chocolate.

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Abstract

The area of Information Science recently got interested in understanding needs and using this notion as a guiding conceptual device to represent and manage PA's services, where the citizen-focused approach requires the individuation of different types of needs. The purpose of this dissertation is to take some steps forward in this direction, trying to distinguish different notions of 'need' able to provide a focus around which PA's services design system can be structured and made accessible. Studying needs-driven services implies taking into consideration cognitive aspects (e.g. citizens'needs, expectations, desires) as well as social aspects (e.g. services, rules, laws, institutions), for the purpose of understanding and communicating relevant knowledge about what we aim to design; ontologies are considered powerful tools in this respect. In this dissertation, we will assume an interdisciplinary research methodology that ranges from philosophical ontology to ontology engineering, as well as cognitive science, philosophy of mind, and knowledge representation. In particular, we will ground this work on DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering). The choice of DOLCE is motivated by its ontological commitment to its being tailored to commonsense representations of cognitive agents, rather than on the constitution of the 'reality' as prescribed by science. This feature brings to the core of DOLCE the importance of modeling mental and social realms and thus makes it particularly suitable for structuring needs-driven services systems. Our analysis will start with reviewing and discussing the contemporary philosophical debate about theories of needs. Then we will attempt to single out different ontological notions of needs and, more specifically, characterize them as a kind of mental attitude. This will bring us to face classic philosophical issues related to intentionality, proposing our theory about intentional objects. Interpreting needs as types of mental attitudes is consistent with most approaches on BDI (belief-desire-intention) models that have been developed for reasoning and planning with mental states. In this respect, we will try to complement the BDI perspective with our theory of needs and intentionality, by providing a formalized ontology of mental states. Finally, the philosophical background will be used to develop an ontology for needs-driven services in Protégé-OWL.

Introduction

Public administration (PA) is a constituent element of political actions directed towards the satisfaction of citizens' needs. The main events of people's lives such as births, deaths, marriages, changes of address, are recorded and managed by PA. Every day, citizens contact the PA's offices in order to obtain identity cards, certificates of professional competence, concession contracts. Furthermore, core services such as transport street lighting, water supply, waste management, education system, healthcare, etc. are provided or controlled by PA. For all these reasons PA is considered to be the 'heaviest service industries' (Peristeras, 2006). Nonetheless, as we shall see, public services are still far from fulfilling citizens' needs and expectations efficiently and effectively. For one thing, this is partly due to cultural heritages concerning the PA's historical development that still negatively affect its operation (Peristeras, 2006). For another thing, PA's action has to deal with the demanding task of providing specific solutions to very different socio-political issues, from particular critical situations that citizens are unable to resolve independently (e.g. disability, disease, poverty), to general matters (e.g. transport, environment, security) that require public resources and organizations. So what exactly is the role of PA?

Actually, we still lack a common definition of PA[1]. As a first approximation, every PA turns out to be a very complex entity whose structure depends on the particular political-institutional structure concerning the specific country it belongs to[2]. Generally speaking, we could define PA as the ultimate means through which we guarantee the public interests (Cammelli, 2014, para. 2.8). This kind of power dates back to historical long-term processes that led to the genesis of the modern state in the 16th century. In a nutshell, the core of these processes is the gradual centralization of power pursued by European monarchies despite the political fragmentation that characterized feudal societies. The main instrument for realizing such centralization was the institution of a technical apparatus composed of qualified personnel whose actions were strictly related to the will of the sovereign.

[1] For a view about various PA's paradigms see (Snellen, 2014).

[2] For example, in Italy PA's structure involves ministries (e.g. Ministery of Economy, Defense), local authorities (e.g. Region, Province, Municipality), agencies (e.g. ANVUR-Agency for the Evaluation of the University and Research Systems), associations (e.g. CONI), independent authorities (CONSOB-the public authority responsible for regulating the Italian financial markets), and many other public institutions.

Regarding this context, Cammelli (2014, para. 2.1) has stressed how taxes and armies underlie PA as we know it today. Historically, specialized bodies acted in order to collect tributes, and this required data on families and production processes and updated documentation systems also with respect to technical knowledge about geography, hydraulics, transport and the organization of building sites, navy yards, foundries that provided equipment and resources for military aspects. Things radically changed with the French revolution and the birth of the constitutional state, where administrations did not adhere anymore to the will of the sovereign but were instead subjected to the law, which defends citizens' public interest. However, PA still remained anchored, in some ways, to the past within the new scenario presented by constitutional states at the turn of the 18th century (Cammelli, 2014, para. 2.2). PA maintained the state of superiority and authority (which typically pertains to sovereigns) in terms of the exercise of power with respect to citizens, a power that is based on a vertical direction that merely aims to control the population. This implies that the communication between PA and citizens was asymmetrical, in other words, PA kept a distance from society observing the 'secrecy of office' about its internal operation that was legitimated by law (Cammelli, 2014, para. 2.2). During the second half of the 19th century, European states started to increase their intervention in society establishing new ministries (e.g. Education, Public works). After the outbreak of the Great Depression, there was a further extension of state action aimed at stabilizing the economy and preserving long-term macro-economic growth. Around the middle of the 20th century, the Welfare state was introduced in order to cope with poverty, social injustice, and support a more equitable distribution of wealth.

> The Welfare State led to growth of PAs all over the world. PAs became massive service providers. Administrative action grew from traditional law enforcement activities to setting up a whole industry of service provision. […] Numerous new services were introduced and PAs started to consume large amounts of the state budget. A new role was added to the state: income redistribution in order to achieve a more coherent and tension-free society. (Peristeras, 2006, p. 10).

In spite of PA's substantial changes that have taken place in the last two centuries and the recent advent of e-Government, Peristeras underlines (2006, p. 11) that nowadays the problem of the asymmetrical communication between PA and society basically has remained more or less the same. Nonetheless, the contemporary administrations' agendas worldwide point out a straightforward new mission with regard to public services: these must be citizen-focused as much as possible and structured as *proactive* rather than *reactive*. Being citizen-focused means that citizens "are no longer considered as subjects to be suppressed, but rather

as clients to be served" (Peristeras, 2006, p. 11). This implies that the traditional asymmetrical communication between PA and citizens should evolve into a symmetrical dialogue, taking directly into consideration citizens' claims, needs, and expectations. Regarding reactive services, we can say that they are those services that are provided to citizens after their specific requests (e.g. asking for driving licenses). On the contrary, as a first step, we can define proactive services as those "services that are provided by the government on their own initiative in accordance with the presumed will of persons and based on the data in the databases belonging to the state information system" (Erlenheim, 2019, p. 10). For example, in some countries parents are automatically entitled to receive a child benefit when a child is born. The public sector has to handle the pressure exerted by many social realities and complex problems including climate change, mobility, immigration, employment, aging, etc. and citizens expect that public services will provide flexible, transparent, responsive, and efficient solutions. Citizens' expectations are related to the satisfaction of their needs, that means that the foremost aim of designing public services should be understanding, identifying, and meeting citizens' needs. But what does having a need mean?

There is currently no consensus about what 'to have a need' exactly means. Intuitively, a need can be defined as absolute or relative, objective or subjective, natural or artificial, endogenous or exogenous, private or social, particular or universal, and so on. Given the relevance of needs for human well-being, through the centuries different disciplines, from philosophy to sociology to economics, as well as anthropology and psychology, have been promoting several theories of needs trying to explain their nature. More recently, the area of information science also got interested in understanding needs and using this notion as a guiding conceptual device to represent and manage consumers' and citizens' necessities. To this aim, a deep analysis of the notion of need is of paramount importance, especially with regard to PA's services design, where the citizen-focused approach requires the individuation of different types of needs (Biccheri et al., 2020; Biccheri & Ferrario, 2019). Generally speaking, the mission of every PA of a Welfare State is that of promoting the fulfillment of human rights and the well-being of the citizens of the community within which it operates. Every citizen has the right to food, health, shelter, justice, safety. Public services are thus aimed at improving the conditions of citizens, by granting a decent level in all the fundamental aspects of living. A way of phrasing the PA mission is by saying that, whenever a citizen's right fails to be actualized, a citizen's need arises, and the satisfaction of that need is what should drive the PA in the first place. Nonetheless, the fruition of citizens' rights is

not the only purpose for the implementation of public services, just as the violation of fundamental rights is not the only trigger of citizen's needs. Citizens have life plans, goals, desires that drive their actions and their interactions within a society. In many cases, to pursue their own private goals within a society, people have to interact with the PA. For instance, when a citizen wants to buy a car to freely circulate, they have to interact with the authority for motor vehicles in order to satisfy their goal. That is, one needs a driving licence to use a vehicle. Hence, a second view of need emerges here, not arising from violation of rights, rather emerging from the goals and the viable means to satisfy those goals. Accordingly, a demand for public services arises, requiring the PA to respond, hence public services may also be motivated by citizens' needs to satisfy their goals. We are here embracing a view of public services that can be termed *need-driven*. To properly articulate such a view, a thorough analysis of needs is in fact required. Even before disentangling the heterogeneous notions of need at work, we have to separate self-ascribed and hetero-ascribed needs, which are respectively related to reactive services and proactive services (Biccheri & Ferrario, 2019). In the former case, a citizen believes that they need something for which an action of the PA is required. Citizens can be entitled to request that the PA enacts a service and the PA may respond to such a request (reactive services). In the latter case, it is the PA that attributes a need to a citizen, usually by proposing a service to satisfy it (proactive service). Proactive services are considered particularly desirable as they reduce the charge on the side of the citizens and allow the PA to fully achieve its mission; on the other hand, they require the PA to be able to correctly ascribe needs to citizens. In principle, citizens best know their own needs, as they have first-person experience of what they are missing, while the PA knows better the means to cope with needs. However, this is not always the case for various reasons. First of all, some citizens (e.g. cognitively impaired citizens or unaccompanied minors) could be not aware – while the PA is – of being in need. Secondly, citizens may know they are in need, without knowing what to ask of the PA, because they are not aware of the services the PA may offer. Also, sometimes the state of need is associated with pain, is urgent, and prevents people from taking prompt action (e.g. health conditions). Thus, in some situations proactive services are required. Moreover, there is a series of needs that are easily predictable for the PA, either because they emerge from the demands of the PA itself (e.g. the issuance of a driver license to allow citizens to drive) or because they are associated with the occurrence of regular life-events (e.g. the birth of a child). Correctly ascribing needs to citizens is the first step to implement useful proactive services. The second and fundamental step is to design services for each specific kind of

citizen (e.g. youngsters, families, elderly, people with disabilities, foreigners, citizens belonging to minorities, etc.) to help them satisfy their particular needs. The final phases are the delivery of services (specific deliveries to specific persons) and their *ex post* evaluation. When designing a service system, all these steps are important. While most of these phases require massive data gathering, the design phase, whose importance is well acknowledged and explained, presupposes a thorough analysis in (at least) two directions (Sirendi et al., 2018). The first one is prominently sociological and is dedicated to understanding what people in certain conditions need. The other is conceptual and focuses on how the information required by the system can be organized and represented in a structured and well-founded manner, to promote accessibility and interoperability. When one talks about need-driven services, at least three different concepts are connected with the use of the term 'need', both in common sense and in scientific discourse (McLeod, 2015). Three very common uses of the term that can be found in the literature are listed below:

1. An event or a state that, if realized, brings about an end goal for an agent (these are referred to in some literature as 'satisfiers'[3]), for instance, the need for a train, bus, or shuttle service to connect the airport with the city center.

2. An event or a state that is necessary to realize for the achievement of an end goal, i.e. if not realized, it prevents the end goal from being achieved (in the philosophical debate these have been defined 'instrumental needs' (Castelfranchi, 1998), i.e. needs whose satisfaction is instrumental to the achievement of some end goal), as for example the need of having a driver license issued for being allowed to circulate in public streets with a car.

3. A very fundamental condition, whose absence causes important damage for persons, universalisable goals (Doyal & Gough., 1991). Examples are the need for food or freedom; these are sometimes called 'absolute' or 'basic' needs, sometimes 'pre-conditions'.

Need-driven services are therefore designed differently, according to the notion of need they refer to. In the first case, satisfying needs would mean finding solutions to help citizens to realize their own goals. In the second case, satisfying needs serves to provide the citizens with those means without which they could not achieve some of their goals. In the third case,

[3] See (McLeod, 2015) and (Max-Neef, 1992).

coping with needs would translate into prioritizing the intervention on the most basic and important aspects of their citizens' lives. Certainly, all these aspects are desirable and should be included in the implementation of need-driven services, but a conceptual clarification is mandatory to be able to reflect on such complex scenarios.

The purpose of this dissertation is to take some steps forward in this direction, trying to distinguish different notions of 'need' able to provide a focus around which PA's services design system can be structured and made accessible. Studying needs-driven services implies taking into consideration cognitive aspects (e.g. citizens' needs, expectations, desires, plans) as well as social aspects (e.g. services, rules, laws, institutions), for the purpose of understanding and communicating relevant knowledge about what we aim to design; ontologies are considered powerful tools in this respect. Nowadays, the term 'ontology' assumes different meanings in different fields. In Philosophy, ontology is traditionally considered to be a branch of metaphysics concerned with the nature of being. Whereas in Computer Science and Artificial Intelligence the word 'ontology' denotes computational artifacts, the means to model and represent through formal language domains of interest for a pragmatic purpose (e.g. the structure of a company with its employees and relationship); in this context 'entities' are information objects whose meaning is made explicit in order to get shareable knowledge (Guarino et al., 2009). In this dissertation, we will assume an interdisciplinary research methodology that ranges from philosophical ontology to ontology engineering, as well as linguistic, cognitive science, philosophy of mind, and knowledge representation. In particular, we will ground this work on DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering). The choice of DOLCE (Masolo, Borgo, et al., 2003) is motivated by its ontological commitment to its being tailored to commonsense representations of cognitive agents, rather than on the constitution of the 'reality' as it is prescribed by science. This feature brings to the core of DOLCE the importance of modeling mental and social realms, and thus makes it particularly suitable for structuring needs-driven services systems.

This being said, we expect that if you are reading this, then there are chances that you are a philosopher or an information scientist interested in PA's services. Given the interdisciplinary nature of the topics covered in this dissertation, in characterizing different themes, we will try to make explicit basic notions and definitions as much as possible to allow the reader, regardless of their educational background, to fully understand the various chapters and the unity of the thesis, which is structured as follows.

In Chapter One we present some of the most important works of contemporary need-theorists, illustrating and commenting core intuitions about the ontological nature of needs, following the two major alternative philosophical positions, that is, instrumentalism and absolutism. We then attempt to single out different notions of needs relevant for our purposes, especially with regard to those needs that can be conceived of as specific kinds of mental states. In Chapter Two, we introduce the philosophical notion of intentionality in order to clarify the relationship between the mental states of need on the one hand and the objects (i.e. satisfiers) toward which such states are directed on the other. More specifically, we propose our theory about intentional objects as roles and highlight in which sense the verb 'need' can be understood as an intentional verb. As we will better see, the matter of intentional objects lay at the heart of our approach. In Chapter Three, we look at different theories about ontology and metaphysics, with special attention to DOLCE's perspective that we adopt to formulate our work. In Chapter Four, we take inspiration from BDI (belief-desire-intention) models, which have been developed for reasoning and planning with mental states, to define the role of needs within practical reasoning and then provide a formalized ontology of intentional mental states where needs are introduced as a particular kind of goal alongside desires. In Chapter Five, we use the formalized concepts to develop an ontology for representing needs-driven services in Protégé-OWL as a starting point that allows service designers to link needs to services by focusing on citizens' mental states. We conclude the thesis by mentioning the limits of our approach and future research lines. Finally, in the Appendix, we attached the RDF/XML syntax that has been employed to serialize our ontology for PA's services[4]. The RDF/XML syntax is the standard format recommended by W3C[5].

[4] However, note that an OWL ontology can be serialized or expressed in a number of different formats (e.g. Turtle syntax, OWL/XML syntax, OWL Functional Syntax).
[5] See https://www.w3.org/TR/rdf-syntax-grammar/

1. Philosophy of needs

1.1 Ontological and moral issues

The contemporary philosophical debate about needs revolves around two main issues: the moral and the ontological one. The former is focused on the problem of individuating and satisfying those needs that should ensure respect for universal human rights and support a more equitable worldwide distribution of wealth. The latter faces the problem of singling out the meaning of 'having a need', or rather what are the essential characteristics that define a need. Let us briefly introduce the two issues, starting with the ontological. In literature, we can find two main different ontological perspectives about needs: *instrumentalism* and *absolutism*[6]. The supporters of the instrumentalist theory believe that all needs are instrumental, that is, they are necessarily ontologically dependent on goals or ends or purposes (in other words, needs could not exist without goals). Philosophers who sustain absolutism, instead, reject this assumption, claiming that although it is true that some needs are instrumental, others are absolute, namely, they can exist independently from goals or purposes. Absolute needs are also known as 'fundamental' or 'categorical' or 'intrinsic' (McLeod, 2014). For example, consider these cases:

(A) Paul needs a camera to take a picture

(B) Maria needs food

(A) shows the typical logical structure of means-end reasoning, where Paul's need for a camera plays an instrumental role for Paul's goal, that is taking a picture. The general conceptual framework that represents an instrumental need is 'A needs X for P', where A stands for an agent, X stands for a resource (an object or an action) and P stands for a goal. Both absolutists and instrumentalists agree upon the fact that (A) is instrumental. Regarding instead (B), an exponent of absolutism would affirm that the need under consideration doesn't ontologically depend on other goals. In fact, Maria's need for food *is an end in itself*, as well as other 'vital needs', like water or shelter. McLeod (2011, pp. 211–213) believes

[6] For an overview, see (McLeod, 2015).

that vital needs are universal; for this reason, they are shared with other organisms (besides, an organism could not have existed without having them). In contrast to other needs, such as the need to smoke, vital needs are those absolute needs that we can't refuse to ascribe to ourselves because they depend on our biological constitution. Clearly, we can refuse to satisfy them. For instance, Maria can refuse to eat, but if she doesn't eat she will be harmed. Wiggins (1987, pp. 10–14) explicitly points out that absolute needs are those the non-satisfaction of which implies harm. In any case, instrumentalist philosophers can still explain (B) in terms of the means-end perspective. For example, it is possible to put forward the idea that the satisfaction of Maria's need for food is necessary for avoiding physiological harm caused by hunger. Therefore, 'avoiding harm' would represent Maria's aim in (B). This interpretation is based on the elliptical thesis, that is: 'A needs X' is a short form to say 'A needs X for P'. This is one of the theses shared by instrumentalists. However, McLeod warns against the risk of confusing the absolutist theory with an instrumentalism-by-the-back-door. In fact, he states that:

> When an absolutist regards an absolute need as a need that must be met for harm to be avoided, this does not result in collapse of the absolute/instrumental distinction. Some beings without ends, goals or purposes of their own, such as plants, can be harmed (McLeod, 2015, p. 6).

To sum up, the topic of dispute between absolutists and instrumentalists is based on the needs' ontological dependence on goals. The former deny that all needs are necessarily ontologically dependent on goals, ends or purposes. The latter state that ontological dependency on goals is a necessary condition for something to be a need. The ontological debate about needs is in fact closely related to the moral one. For instance, instrumentalists argue that the moral value of needs hinges upon the related goals (e.g., Barry, 1965). In other words, needs are relevant only if goals on which they depend are relevant, that is the value of needs is derived from the value of goals. By contrast, absolutists believe that the value of some needs, namely absolute needs, is intrinsic to needs themselves (e.g., Allen & Alvarez, 2009). The concept of need is frequently used in contemporary political and social discourses because of its 'special moral force', that is: needing something seems to entail a greater moral significance than just desiring or preferring something and thus implies certain political responsibilities (Wiggins, 1987; Frankfurt, 1984; Brock, 1998). Formulating public policies grounded in the language of needs would require, among others, making a sort of normative list of what citizens need. Determining citizens' needs is a very demanding task, since a person could claim to need a high-tech laptop, whereas others could claim to need an

unemployment benefit, these are quite different notions of need that should be evaluated very differently from a moral standpoint. There is therefore a certain degree of perceived relativism about needs (Brock, 1998, p. 2). In any case, the aim of public policies is not that of satisfying every kind of citizens' perceived need, but only the ones that are morally and socially relevant:

> Not all needs expressed by societal entities are eligible to be handled by governance entities. The governance system, and more precisely the political sub-system, each time chooses from a superset only a subset of needs to be addressed. The goals to be fulfilled by the political system are set based on these selected needs. These goals are socially defined through interaction amongst the governance and societal entities (Peristeras, 2006, p. 75).

The question is, which types of needs, according to their moral significance, should be determined by public policies?

Actually, first we should be able to define what 'to have a need' means so as to answer the question above, which means the moral issue is subordinated to the ontological one. In this dissertation, we are going to discuss only the latter, believing that rigorous ontological analysis is mandatory and preliminary to any attempt to formulate public policies that espouse the normative force of needs. Although coping with the moral issue is far beyond the scope of this work, paying attention to some normative aspects will be useful to shed light on the ontological matter. As we shall see, it is far from easy to try and suggest a clear definition of need. In fact, the meaning of the word 'need' is ambiguous and full of antinomic nuances. A need can be defined as absolute or instrumental, objective or subjective, natural or artificial, endogenous or exogenous, private or social, particular or universal, and so on. Moreover, the notion of need is often conflated with apparently similar concepts such as desire, preference, capability.

In this chapter, we will review some of the most important works of contemporary need-theorists, illustrating and commenting core intuitions about the ontological nature of needs, following the two major alternative philosophical positions sketched above, that is, instrumentalism and absolutism. We will start out by introducing the latter, given that absolutism is considered to be the standard view among contemporary philosophers of needs.

1.2 Absolutism

As we have mentioned earlier, in contrast to instrumentalists, absolutists assert that some needs are not dependent on goals, namely, they are absolute. Probably, the most influential account concerning the absolutist approach to needs refers to David Wiggins. First of all,

Wiggins puts the focus on the difference between needs on the one hand and desires or preferences on the other. He argues that we should not think about needs as a special kind of desire, as if needs were nothing but strong desires or preferences (Wiggins, 1987). Intuitively, it is easy to see why needs and desires don't overlap: someone could desire something without needing it, and he could desire it in a more or less conscious state. Conversely, someone could need something without desiring it (Wiggins & Dermen, 1987). In addition, in order to need something, it is not necessary to be conscious at all of it, e.g., people in a coma are not aware of specific treatments and drugs they need (Biccheri & Ferrario, 2019). Furthermore, Wiggins affirms that:

> If I want to have x and x = y, then I do not want necessarily to have y. If I want to eat that oyster, and that oyster is the oyster that will consign me to oblivion, it doesn't follow that I want to eat the oyster that will consign me to oblivion. But with needs it is different. I can only need to have x if anything identical with x is something that I need. Unlike "desire" or "want" then, "need" is not evidently an intentional verb (Wiggins, 1987, p. 6).

According to Wiggins, these facts are consequences of a more general reason, namely needs, contrary to desires, are not so much dependent on thoughts but rather on the way the world really is (Wiggins, 1987, p. 6; Wiggins & Dermen, 1987, p. 62). Thus, in Wiggins' opinion, it seems almost that needs are independent of what people believe, they entail a stronger commitment to reality than desires. It is worth noting that, in the above passage, this observation is supported by the following main argument: contrary to 'desire', 'need' is not an intentional verb. However, this is controversial. The notion of 'intentional verb' is rather arguable. In brief, intentional verbs are those verbs that are used to talk about intentional mental states (Ciecierski, 2016) [7]. This is a linguistic approach to intentionality that attempts to pick out the class of intentional mental states by appealing to criteria that are applied to intentional sentences in which intentional verbs appear. Unfortunately, the linguistic way of understanding intentionality turns out to be quite circular. Although in different ways, it ends up invoking the concept of 'intentional mental state' in order to define what intentional verbs are, therefore "it might be better to approach the concept of the intentional state in a more direct, and to a large extent non-linguistic, manner. A manner that combines semantic studies with ontological, methodological and formal considerations, as well as with inquiries into philosophical interpretations of empirical results" (Ciecierski, 2016, p. 54). The linguistic

[7] As is well known, intentional mental states exhibit the feature of intentionality, namely the property of being about something, i.e. about intentional objects. Although there are different types of mental states (beliefs, desires, perceptions are among the most common examples), they all share the property of intentionality, which somehow links them to their intentional object (e.g. if Maria desires Luigi, then 'Luigi' is the intentional object of Maria's intentional state of desire).

approach offers interesting insights but does not provide necessary and sufficient conditions to establish criteria for determining the notion of intentionality (Voltolini & Calabi, 2009, Chapter 2). We shall discuss in due course the topic of intentionality, now let us return to Wiggins' analysis of needs. Once having drawn a distinction between needs and desires, Wiggins can take into consideration the concept of need in more detail, recognizing that basically there are two types of needs: an *instrumental* one and a *categorical* or *absolute* one. Though both are legitimate conceptual distinctions, only the absolute side of need is what really matters in the context of human rights and duties; it is in virtue of its categorical sense that a need claim has a particular moral force (Wiggins, 1987, p. 10). On the contrary, instrumental needs are such because they refer to a goal or purpose without which they would lose their meaning. Let's see how Wiggins introduces his ideas about the two kinds of needs, starting with instrumental needs:

> Something that has been insisted upon in most analytical account of needing is that needing is by its nature needing for a purpose and that the statements of need that do not mention relevant purposes (or 'end-states' as White calls them) are elliptical. […] One thing seems right with this claim, and another seems wrong (Wiggins, 1987, p. 7)

For one thing, Wiggins recognizes that in our everyday speech we use to make claims about needs that are purely instrumental, in Wiggins' example "I now need to have $ 200 to buy a suit" (Wiggins, 1987, p. 8). These claims are represented by the following formula: A needs X for Y, where A stands for an agent, X stands for a resource (an object or an action) and Y stands for a goal. Sometimes, instrumental needs claims are expressed elliptically, that is without explicitly declaring the related goal (e.g. I need $ 200). Nonetheless, the substance doesn't change (Wiggins, 1987, p. 8). The elliptical locution, that is 'A needs X' is nothing but a short form to say 'A needs X for Y'. So when someone claims an instrumental need, is never inappropriate to ask 'what do you need for?' meaning 'what is your goal?'. It is quite evident that doing/getting X is the condition that A has to satisfy in order to achieve Y. In other words, X is an instrumental goal with respect to the end goal Y. For instance, 'having £ 200' is the instrumental goal that has to be realized so as to achieve the related end goal 'buying a suit that costs $ 200'. It is worth noting a couple of things concerning the above formula: A) if the agent lost interest in achieving the end goal, then she would drop the related instrumental goal (e.g. if I lost interest in buying the suit, then automatically I would not need to have $ 200). This shows how instrumental needs are closely linked to end goals; B) needs necessarily have an associated time parameter 't', in Wiggins' example the parameter is represented by the word 'now'. Generally speaking, the parameter expresses a

time limit within which needs, both instrumental and absolute, have to be satisfied (the time constraint sheds light on a certain 'urgency' that, as we shall see later, pushes to satisfy needs). For another thing, as mentioned, Wiggins contrasts instrumental needs with absolute or categorical needs. Absolute needs claims assume the form 'A need X', but differently from instrumental needs, that form does not hide an elliptical sense. Namely, there are not implicit goals or purposes on which needs depend, rather the "purpose is already fixed, and fixed in virtue of the meaning of the word" (Wiggins, 1987, p. 9). In other words, the purpose could be seen as the need itself. Wiggins believes that a need, in this sense, is equivalent to Aristotle's characterization of 'necessity' or 'thing that is necessary' (Wiggins & Dermen, 1987, p. 62). Wiggins puts the point as follows:

> it would have been Aristotle's view that I need to have x if and only if my having x is a precondition, things being what they are, of my continuing to live and/or a precondition, things being what they are, of my enjoying good or ridding myself of evil. On this view, my needing x is a state or condition of dependency upon x with respect to some (in the situation) non-negotiable good of avoiding some independently specifiable harm. Needing x is a dependency upon having x in particular. For instance, a thirty-five-year-old woman's need for calcium is a state of dependency, with respect to the avoidance of independently specifiable harms such as osteoporosis or whatever, on the intake of calcium (Wiggins & Dermen, 1987, p. 63).

Thus, Wiggins explicitly defines absolute needs as those for which the non-satisfaction implies harm. When someone needs X, they are in a state or condition of dependency upon X, such that if they did not get or use X, then they would be somehow harmed. According to Wiggins, an absolute need claim such as 'A needs X' is not subjected to questioning like 'what do you need it for?' or 'what is your goal or aim?'; if someone asked *bona fide* these kinds of questions, they would deliberately misunderstand what to have an absolute need means (Wiggins, 1987, p. 8). Anyway, philosophers who sustain the instrumentalist theory could argue that 'avoiding harms' is precisely the goal that drives absolute needs. If that was the case, it would not make sense to talk about absolute needs, because all needs would be dependent on something or other as indeed instrumentalists expect. With respect to this objection, we agree with Mcleod (2015) that instrumentalists simply miss the point concerning the aspect of the harm linked to needs. Even if Wiggins does not put it this way, we believe that 'avoiding harm' is not a goal or purpose that drives our behaviour, rather, as we will see later on, it is just a consequence *of an unmet need based on a physical negative perception or a psychological experience, such as frustration*. Having said this, Wiggins goes on to carry out an indepth analysis of the question of harm, distinguishing between different aspects such as the *badness* or *gravity* of harms concerning unmet needs and their

urgency. Furthermore, he defines four relevant kinds of needs: 1) *Basic needs* that are based on natural laws, unalterable and invariable environmental facts, or facts about the human constitution; 2) *Entrenched needs* that are hardly modifiable; 3) *Substitutable needs* that, as opposed to the entrenched ones, are easier to modify; 4) *vital needs* that are, at the same time, bad, entrenched, and hardly replaceable. (Wiggins, 1987, pp. 14–17; Wiggins & Dermen, 1987, pp. 64–65). As we have seen, human harms play an essential role in Wiggins' account of absolute needs, though appealing to harms is questionable. First of all, what do we mean by 'harm'?

What counts as harm is relative to people's conceptions about suffering and wretchedness, and could be interpreted differently according to different cultures. Although Wiggins admits the cultural discrepancy concerning the concept of harm, he insists on advocating the idea that harms represent a kind of undeniable index of absolute needs' level of satisfaction, an essential category for interpreting which needs are relevant to ensure human well-being and flourishing and thus which needs should be addressed by public policies (Wiggins, 1987, p. 11; Wiggins & Dermen, 1987, p. 63). Even if Wiggins was right, the notion of harm that he uses is too broad to qualify absolute needs as such. It is worth noting that, according to him, absolute needs are all needs that, first, can be expressed through the non-elliptical formula 'A needs X'; second, they imply unescapable harms once we are not able to satisfy them. There is no doubt that unmet absolute needs (e.g. need for calcium) imply unavoidable harms, but can we say the same for unmet instrumental needs?

Let us consider, for explanatory purposes, a simple example that shows how unmet instrumental needs could be harmful in the same way as absolute needs are. Maria is a single woman with two young children and she is going to undergo a heart surgical operation. Maria believes that she will be hospitalized for a month and that, during this period, she will not be able to take care of her children and that there are no friends or relatives that can do it for her, as she has just moved to a new place, far away from where she used to live and it would be too much of a burden to ask anyone. Obviously, Maria desires the wellness of her children, she wants that they are fit, well-fed, and keep going to school throughout her rehab period. At this point, Maria starts thinking she needs a qualified person who will be able to look after her children and asks for the help of a social worker from social services (Biccheri & Ferrario, 2019). Now, it is easy to see why Marias' need is an instrumental one: it can be expressed through the formula A needs X for Y, that is 'Maria needs a social worker to ensure the well-being of her children'. Given Maria's life situation, there is no alternative, she needs the help of social services; if Maria's need was not met, she would be harmed,

because no one is going to take care of her children. Thus defining absolute needs as those needs that if not satisfied cause harms (understood in the sense of unavoidable damage) is fairly approximate, considering this can also be true for instrumental needs. Furthermore, harm avoidance is not the only universal parameter with which it is possible to evaluate the relevance of needs. For instance, Grix and McKibbin (2016, Chapter 24) suggest classifying needs and their normative force on the basis of degrees of well-being that they entail[8]. Wiggins' theory offers criteria to distinguish absolute needs from instrumental ones, arguing that only the former should be deemed worthy of being morally relevant. However, Wiggins does not specify or exemplify a definite class of absolute needs[9].

Besides Wiggins, an important exponent of the philosophical movement close to the absolutism position is the Chilean economist Manfred Max-Neef, most famous for his work *Human Scale Development: Conception, Application and Further Reflections* (1991). Max-Neef proposes a taxonomy where needs are classified on the one hand through the *existential categories* of being, having, doing and interacting and, on the other hand, according to the *axiological categories* of subsistence, protection, affection, understanding, participation, idleness, creation, identity. More precisely, Neef calls these needs 'fundamental'; by the way, he postulates that these needs

> have existed since the origins of 'homo habilis' and, undoubtedly, since the appearance of 'homo sapiens'. Probably at a later stage of evolution the need for Identity appeared and, at a much later date, the need for Freedom. In much the same way, it is likely that in the future the need for Transcendence, which is not included in our proposal, as we do not yet consider it universal, will become as universal as the other needs. It seems legitimate, then, to assume that fundamental human needs change with the pace of human evolution. That is to say, at a very slow rate. Therefore, fundamental human needs are not only universal but are also entwined with the evolution of the species (Max-Neef, 1992, p. 27).

For one thing, fundamental human needs can be conceptualized as absolute needs in the sense defined by Wiggins, since they are not dependent on specific people's goals or purposes, rather they are linked to the early date of human evolution. Moreover, every fundamental human need "not adequately satisfied generates a pathology" (Max-Neef, 1992, p. 22), similarly to Wiggins' view about the relationship between unmet absolute needs and harms. Max-Neef 's concept of 'pathology' is strictly related to economic and political issues, such as unemployment, hyperinflation, external debt, violations of human rights,

[8] Anyway, the majority of contemporary needs-theorists have focused on the notion of harm to determine needs' normative values. See for example (Feinberg, 1973), (Miller, 1979), (Frankfurt, 1984), (Thomson, 1987).

[9] Wiggins' distinction between absolute and instrumental needs has been taken up by philosophers like McLeod (2011, 2014), Thomson (1987), Reader (2006), Brock & Reader (2002).

marginalization, and is hinged on a reinterpretation of the problem of poverty understood as a plurality of fundamental human needs that are not adequately satisfied (Max-Neef, 1992, pp. 19–23). For another thing, fundamental needs are explicitly said to be universal, contrary to Wiggins' absolute needs that are not necessarily universal. From this universal perspective, Max-Neef contends a theory of human development, both in an economic and ethical sense, that rests upon fundamental needs and adopts an interdisciplinary approach, ranging from economy to history, and from philosophy to anthropology. According to Max-Neef, development is a matter of people, not objects, therefore in order to measure human well-being, we should focus not only on quantitative indicators, such as the GNP (gross national products), but also on qualitative indicators, and the analysis of fundamental needs satisfaction might be suitable for this purpose:

> What determines people's quality of life? Quality of life depends on the possibilities people have to adequately satisfy their fundamental human needs. […] What are those fundamental human needs, and/or who decides what they are? These questions need to be examined before any answers can be suggested (Max-Neef, 1992, p. 16).

Concerning the study of human needs, it is generally accepted that needs differ depending on cultures, environments, historical periods, they change over time and this would entail generating new needs. In Max-Neef 's opinion, these common beliefs are simply inaccurate, being the result of a conceptual shortcoming, namely the failure to distinguish between *needs* and their *satisfier.* This is a pivotal distinction that has been neglected too many times in the literature about needs. Broadly speaking, a satisfier is whatever has the function of satisfying a need; in other words, we must distinguish between a 'need about x' and 'x', which is the need's satisfier (e.g. the need for iron is not the iron itself). Whereas, in the strict sense, Max-Neef defines satisfiers as "the way in which a need is expressed" (1992, p. 25). For example, physical health, food, shelter are satisfiers of the need for subsistence. There is not biunivocal correspondence between needs and satisfiers, that is, there are many satisfiers which can satisfy a specific need, and *vice versa*. For instance, the need for protection can be fulfilled by different satisfiers, including care, adaptability, autonomy, and the same satisfier, let's say 'adaptability', can fulfill both needs for protection and subsistence. Max-Neef gives many examples of possible satisfiers within the already mentioned system classification of needs. However, the list of satisfiers provided by Max-Neef has no normative or conclusive pretensions. Satisfiers, in fact, can change considerably according to time, cultures, and circumstances (Max-Neef, 1992, p. 31). In contrast to satisfiers, fundamental needs are finite, few, classifiable, and universal, that is they are the same in all cultures and in all

historical periods (Max-Neef, 1992, p. 19). Given the scant of empirical evidence concerning the fact that fundamental needs are culturally and historically constant, taking the universality of human needs seriously means supporting a very contestable thesis. Anyway, as Max-Neef affirms, "there is nothing that prevents us from speaking of their socio-universal character because people everywhere want to satisfy their needs" (1992, p. 27). Max-Neef fosters a systematic approach where needs are conceived to be strongly interrelated and interactive. Simultaneities, complementarities, and trade-offs characterize the way in which needs are typically satisfied, for example, "a mother breastfeeding her baby is simultaneously satisfying the infant's needs for Subsistence, Protection, Affection and Identity" (Max-Neef, 1992, p. 17). The Chilean economist thinks that needs represent the essence of human beings, which is expressed by two main and opposite qualities that are *deprivation* and *potential*.

While it is common to think about needs in terms of something which is lacking and therefore potentially harmful, seeing needs as proactive human attitudes is a quite original standpoint. In fact, to the extent that needs motivate and prompt people to action, they are a precious resource, for example, the "need to participate is a potential for participation, just as the need for affection is a potential for affection" (Max-Neef, 1992, p. 24). However, Max-Neef's major contribution to the philosophy of needs is undoubtedly the accurate analysis of needs interpreted in the light of satisfiers.

Max-Neef 's theory of satisfiers and his holistic approach to needs, together with Wiggins' reflections on the relationship between needs and harms, have been embraced and developed by Doyal and Gough in their very influential book *A Theory of Human Need* (1991). Here, however, unlike Wiggins and Max-Neef, the authors support a view about needs that is genuinely instrumental. Up to this point, we have thoroughly discussed the core theoretical theses that underpin the absolutist perspective. Now let us concentrate on the philosophy of instrumentalism, introducing Doyal and Gough's theory in which human needs are seen as *universalisable* goals.

1.3 Instrumentalism

According to Doyal and Gough, needs are a specific kind of goal, in the same fashion as *wants*, albeit unlike the latter, the former are universalisable. Before discussing the question of goals and universal values, it is worth noting that needs' theorists often strive to conceptually clarify the nature of needs contrasting them to *desires*. In doing so, some

philosophers use the term ‘want’ instead of ‘desire’, even if they are not always synonymous. As Davis has stressed (1984), on the one hand, the word ‘desire’ can be synonymous with ‘want’, ‘wish’, and ‘would like’; in this case, a desire has a *volitive* meaning because it expresses a sense based on reasons or aims (e.g. someone could desire to eat in order to get nourishment). On the other hand, the verb ‘desire’ entails an *appetitive* sense that is close to the meaning expressed by verbs like ‘hunger’, ‘crave’, ‘yearn’, ‘long’, ‘urge’. Appetitive desires, in contrast to volitive desires, do not necessitate aims, there “may be reasons why we have a desire to eat (such as food-deprivation), but we do not have reasons for having a desire to eat, ‘Why do you have an appetite?’ is a legitimate question; ‘What are your reasons for having an appetite?’ is not” (Davis, 1984). Appetitive desires so conceived seem to be very similar to the Freudian notion of ‘drive’, an inner motivational force that arises out of a “stimulation or impulse of a passing need” (Bernet, 2013/2020, p. 113). Not only desires but also needs themselves can be interpreted as drives. This approach is at the basis of the most famous classic theory of human needs in psychology, which is Maslow’s theory, where needs are ordered according to the principle that, among needs, some of them would be more fundamental or urgent to be satisfied, compared to others. Maslow’s hierarchy is grounded on five categories of needs, which are: physiological, security, social, esteem, self-actualization (Maslow, 1943). Having said this, what do Doyal and Gough mean by ‘want’? Moreover, are needs somehow comparable to drives within their theory?

As we already mentioned, in Doyal and Gough’s opinion desires, as well as needs, are goals to be achieved. Since achieving goals presupposes having some reasons that engender a commitment toward the realization of goals themselves, we can assume that they give a volitional meaning to wants. Furthermore, Doyal and Gough strongly reject Maslow’s theory, arguing that we should distinguish between needs and drives, because “one can have a drive to consume something, like lots of alcohol, which one does not need and at the same time have a need for something, like exercise or to diet, which one is in no way driven to seek” (Doyal & Gough., 1991, p. 36). Therefore, needs and wants *qua* goals are different from drives or appetitive desires. But what is the difference that exists between wants and needs to the extent that both are conceived of as goals?

Before answering the question, it is necessary to make one last point about nuances of meaning related to the verb ‘want’. Doyal and Gough seem to use ‘want’ as an interchangeable term with the economic notion of ‘preference’ (cf. Doyal & Gough., 1991). In this respect, ‘preference’ expresses a psychological state that, within the standard consumer theory, is modeled through utility functions and identified by observing choices

between available goods.[10] For instance, "If a collection of goods y could have been bought by a certain individual within his budget when he in fact was observed to buy another collection x, it is to be presumed that he has revealed a preference for x over y" (Sen, 1973). This being said, wants or preferences are linked to people's beliefs and cultural environments, thus vary from one person to another, while needs are 'objective' given that they are independent of beliefs. But most importantly, the needs' objectivity derives from the fact that needs are believed to be universal in so far as the following conditional holds for everyone: if needs were not satisfied, they would entail serious harms. Therefore Doyal and Gough evidently endorse Wiggins' concept of harm, though with some not indifferent additions: 1) compared with Wiggins's theory, the notion of harm is better specified in terms of impaired goals achievement and precluded social participation; 2) all needs are deemed to be instrumental goals.

Both points seem to be strictly dependent on each other and related to the conceptualization of *basic needs*, so let us see how. People pursue goals that in their opinion are believed to be of some value and if they fail to achieve them, they usually feel sad, depressed, or frustrated. In any way, these negative feelings are not examples of harms, at least from Doyal and Gough's perspective. Being harmed is not like trying to achieve a goal without success and suffering the consequences of having missed the goal. Rather, someone is harmed when they are disenfranchised from the possibility of achieving goals *tout court*, in Doyal and Gough's words:

> To be seriously harmed is thus to be fundamentally disabled in the pursuit of one's vision of the good. Thought of in these terms, the objectivity of harm is ensured through its not being reducible to contingent subjective feelings like anxiety or sadness […] Basic human needs, then stipulate what persons must achieve if they are to avoid sustained and serious harm in these terms (1991, p. 50).

Avoiding harms requires a certain degree of autonomy with regard to human action which in turn implies developed forms of social participation:

> Unless individuals are capable of participating in some form of life without arbitrary and serious limitations being placed on what they attempt to accomplish, their potential for private and public success will remain unfulfilled – whatever the detail of their actual choices. Whatever our private and public goals, they must always be achieved on the basis of successful interaction, past, present or future, with others. Our entire lives – even when we are alone – are dominated by what we learn from others, how they assess what we think

[10] Kuklis points out that the standard consumer theory conflates preferences and needs, although "there is a perceived difference between needs and preferences which requires consideration in empirical applications" (2005, p. 81).

> we have learned and how they respond to changes in our actions on the basis of such assessment (Doyal & Gough., 1991, p. 50).

Doyal and Gough link human needs to prior conditions that are necessary to allow the improvement of social functioning and describe basic human needs as "the universalisable preconditions for non-impaired participation in any form of life" (Gough, 2015, p. 11). So, to pursue goals, regardless of cultural, economic, and geographical differences, people have to meet certain preconditions, that can be seen in their turn as basic goals or needs. Needs, seen as goals, can have a hierarchical structure, for example, starting "from some overall goal – like physical warmth – the means by which it is sought (e.g. specific types of clothing) again can be thought of as ends in their own right" (Doyal & Gough., 1991, p. 40). Doyal and Gough believe that the grammar of statements concerning needs is always based on an instrumental language, including, as we know by now, elliptical claims such as 'A needs X' that actually is a short form of 'A needs X for Y', where 'Y' is the goal. According to Doyal and Gough, *basic needs* or *universalizable goals* are often ellitpical, thus goals on which these needs depend are left implicit:

> When needs are viewed as universalisable goals, the Y of the piece – the avoidance of serious harm – is often implicit and the attention of those in pursuit of their needs is focused on how to go about achieving the X. Very often in the developed world, for example, the goal of acquiring food is pursued without a thought of the harm that will ensue if the pursuit is unsuccessful. The goal that is paramount is simply the fact that the shopping must be done and primary attention is on how best strategically to do it (Doyal & Gough., 1991, p. 40).

As we can see in the above passage, relating to basic needs Doyal and Gough affirm that the goal that often is not made explicit is 'avoiding serious harms', by thus embracing the most classic instrumentalist position. But what are the basic needs proposed by Doyal and Gough? The most basic kinds of needs are *physical health* and *autonomy.* The former is an essential condition for being able to deal with everyday activities, whether they be intellectual or manual, the latter is the "ability to make informed choices about what should be done and how to go about doing it" (Doyal & Gough., 1991, p. 53). For one thing, 'autonomy' is synonymous with 'agency', which implies being able to formulate aims and having beliefs about how to achieve them; in this sense, autonomy is expressed by cognitive and emotional capacities that drive our actions. For another thing, the word 'autonomy' involves a broader meaning than 'agency' in the strict sense, that is the cultural and educational environment in which people live, forming their own personality and cultural heritage (Gough, 2015). Human needs have also a biological background that has been modelled by evolution

through the ages, for example, the "mammalian constitution shapes our needs for such things as food and warmth in order to survive and maintain health. Our cognitive aptitudes and the bases of our emotionality in childhood shape many other needs – for supportive and close relationships with others" (Doyal & Gough., 1991, p. 37). Nonetheless, genetic constraints do not predispose our behavior in a deterministic manner (Doyal & Gough., 1991, pp. 36–37). For instance, biologically speaking we definitely need food and water to survive, but we do not need to smoke cigarettes.

Moreover, following Max-Neef (1992), Doyal and Gough make a distinction between needs and satisfiers. However, differently from the Chilean economist, they are interested in pointing out satisfiers that, in principle, could be applied to all human beings with respect to the satisfaction of basic needs. Suggesting the notion of 'universal satisfiers characteristics (USCs)', Doyal and Gough aim to determine properties or characteristics that are shared by different satisfiers able to address basic needs, USCs "are thus those properties of goods, services, activities and relationships which enhance physical health and human autonomy in all cultures. For example, calories a day for a specified group of people constitutes a characteristic of (most) foodstuffs which has transcultural relevance" (Gough, 2015, p. 16). USCs are grouped in the following list:

- Nutritional food and clean water
- Protective housing
- A non-hazardous work environment
- A non-hazardous physical environment
- Appropriate health care
- Security in childhood
- Significant primary relationships
- Physical security
- Economic security
- Appropriate education
- Safe birth control and child-bearing.

USCs, in addition to be basic needs' satisfiers, are interpreted in their turn as goals to pursue, and as such, they represent another category of needs that Doyal and Gough call 'Intermediate needs'. These needs are conceptualized as second-order goals (SOGs) with

respect to basic needs, which count as first-order goals (FOGs) to be achieved. The point is that second-order goals "must be achieved if the first-order goals of health and autonomy are to be attained" (Doyal & Gough., 1991, p. 157). It is interesting to note that, since SOGs satisfy FOGs, needs themselves can be included within the class of satisfiers. Within instrumentalist philosophical positions, Doyal and Gough's theory has the merit of highlighting the fact that *needs themselves are goals*. If we attempted to classify needs as goals, we could individuate two subclasses: *instrumental goals and end goals.* The former can be considered as a means to an end, in other words, the achievement of the instrumental goal is necessary to reach what, in the final analysis, we aim for, whereas the latter can be conceived of as a goal in its own right. In this regard, SOGs can be considered to be instrumental goals with respect to FOGS, which are end goals.

Apart from Doyal and Gough's works, the notion of 'need' as a kind of goal plays a fundamental role also in the theory of goal-directed behavior proposed by Cristiano Castelfranchi. Within the domain of cognitive sciences, Castelfranchi advocates the relevance of emotions and feelings with regard to the characterization of mental states. In this respect, he is interested in distinguishing between *having a need for something* and *feeling the need for something*. According to Castelfranchi, needs are, as we shall shortly see, a special kind of goal. Only teleonomic or goal-oriented systems, be it living beings or not, can have needs, thus "If a system does not have goals (in any sense: either internally represented and controlling its behaviour; or as adaptive functions giving a teleonomic perspective to its behaviour, or as artificial functions to be satisfied) it cannot have needs" (Castelfranchi, 1998, p. 56). Sentences like 'the knife needs sharpening' or 'the car needs oil' are part of our everyday language. In these cases, we attribute needs to objects on the basis of their functions; these kinds of needs are called 'objective'. Note that, in principle, we can attribute needs to every kind of entity to the extent that these have some functions with respect to human goals, for example, a mountain could have a need, in so far as "we are attributing it some function-use like 'being good ground for skiing'" (Castelfranchi, 1998, p. 56). Anyway, *having* a need does not entail *feeling* it, not even if we attribute objective needs to other human beings. For instance, Paul could have an iron deficiency and not knowing it, because he can't *feel* his iron deficiency. Nonetheless, his physician could inform him about it. So Paul would be conscious of his need only through a third-person knowledge, that is a physician's knowledge. But what does it mean to feel a need?

First of all, we should keep in mind that all needs, either objective or felt, are special types of instrumental goals that are 'negatively conceptualized', that is agents see needs in terms

of negative perspective with respect to the achievement of the end goal. In fact, when "we say that 'x needs y/q for p', we say that if x does not have y/q, x will not realize p. And we usually also presuppose that currently x has not y/q" (Castelfranchi, 1998, p. 56). In other words, needs are synonymous with 'lack' or 'deprivation'. Concerning the instrumental formula, that is 'X needs Y to P', obtaining/realizing the satisfier 'Y' is necessary to achieve the end goal 'P'. Castelfranchi describes the cognitive schema that underpins the theory of instrumental needs as follows:

- X has a goal p;
- For this goal, q (action or situation) or y (a resource) needed, q=y is a potential sub-goal;
- X lacks it;
- So, X cannot achieve p. (Castelfranchi, 1998, p. 56)

The schema draws attention to minimum requirements related to the characterization of instrumental needs in general. Returning to the question of feeling needs, an agent has a *perceived* or *felt* need 'F' if they have a body able to perceive some pain, disturbance, or unpleasant sensation 'S'. Anyway, perceiving 'S' is not sufficient to feel a need, self-perception is also necessary, namely, the agent has to perceive that 'S' is a signal from their body, hence being aware that they are the bearer of their need. Finally, the agent must have a belief about the satisfier 'R' with respect to the need 'F' and must be able to attribute (through a declarative belief or a causal mental model) the sensation 'S' to the lack of 'R'. Put it simply, the agent must identify the reasons for their negative feelings, believing that these feelings are linked to the lack of the satisfier:

> Such a belief is fundamental for "x feeling the need for y". Without this attributional representation x can feel bad, and can have the need for y/q (and even be aware of it), but she cannot "feel" this need. When we feel a need we are feeling something and we interpret it as the lack of what we are lacking. Thus, a small baby desperately crying with hunger, feels uneasiness or pain, feels hungry, and has a need for milk. She might even be expecting and desiring milk (on the basis of associations and previous experience) but does not really "feel the need for milk" since she is not subjectively linking her pain to the lack of milk (Castelfranchi, 1998, p. 56).

However, the hypothesis that attributional beliefs (which causally link a sensation of pain to the lack of something) are necessary conditions to feel a need, seems to be quite strong. This thesis implies that neither infants nor other living beings such as plants and animals, which do not have a cognitive system equipped with developed linguistic or logical reasoning abilities, can feel needs. It is for this reason that Castelfranchi provides a weaker notion of 'feeling the need for something', that brings into play simple associative relationships

between unpleasant sensations and related satisfiers and are based on anticipatory representations. In this respect, Castelfranchi affirms:

> I suppose for example that Skinner's instrumental learning might be modelled in this way (without postulating a real goal-directed, purposive behaviour): the animal, given certain active drive (for ex, hunger), activates a response (to press the bar) just because on the basis of its previous (accidental) experience it associated this action to this condition as successful, and also associated the expectation of food. It expects the food. At this point, given this anticipatory mental representation of the result of the action, I would like to say that the animal start to act "for" the food, and start to feel the need "for" the food. In fact it not only feels the hunger's stimulus that elicit a behavior, but it associates to this an expectation of x. This anticipatory representation of x related to the disturbance sensation is to me the minimal condition for "feeling the need for" (Castelfranchi, 1998, p. 59).

In light of the above, it is clear why needs are commonly perceived as very compelling motives. First, they are conceived as instrumental to the end goal's achievement, as without what is needed, what is aimed at cannot be reached or, in other words, we must obtain what we need before (and for) obtaining what we aim at. Furthermore, needs are thought of as negative mental states, that is in terms of deprivation (i.e. if someone needs x, then they lack x) and are related to unpleasant sensations of pain. According to Castelfranchi, desires are also goals even if, differently from needs, they are more 'positive' in the sense that they imply pleasurable experiences. This pleasure does not refer only to the satisfaction that you could feel once the goal has been achieved, but also to a 'virtual mental activity' that can be experienced in anticipating the moment in which the goal will be fulfilled. When someone desires something, they do it by means of a simulation, a mental representation that "implies some (partial) imagined sensation (for example the taste of a food; the joy of a sexual encounter). What you feel is this sensation: an anticipated part of the sensation you will (would) experience; illusory gratification" (Castelfranchi, 1998, p. 57). To sum up, needs and desires are special kinds of goals because of their being 'anchored' to bodily perceptions and in this are really different from more abstract goals, like for instance intentions, we "cannot 'feel the intention of'' or 'feel the objective, the plan, the aim, the purpose, the intent, the end of!'" (Castelfranchi, 1998, p. 57). Up until now, we have spoken much about goals, but what does it mean to have a goal?

Defining the nature of goals is the knot to untie as regards the dispute between instrumentalists and absolutists. In the next section, we shall take into account two different notions of goals that will be helpful to get to the heart of the ontological issue related to the philosophy of needs.

1.4 Goals and pseudo-goals

Let us remind once again that absolutists deny that all needs are necessarily ontologically dependent on goals, while instrumentalists state that ontological dependency on goals is a necessary condition for something to be a need. The strength of one or the other philosophical positions much depends on what is meant by 'goal'. Mcleod (2015) points out that there is no agreement between instrumentalists concerning the notion of goal: either a goal is understood as an agent's mental representation, whether conscious or not, directed towards a state of affairs that the agent would like to bring about, or as a function, an outcome related to an organism's natural activities, which do not necessarily entail mental skills and are not teleologically directed. Mcleod (2015) appeals to a Hacker's passage to make the latter kinds of goals more clear:

> The organs of a plant have a purpose or a function, which is their contribution to maintaining the normal life and reproductive cycle of the plant. But a plant itself cannot be said to have purposes of its own or to pursue goals. Nevertheless, what a plant does is explained teleologically – that is, as being done for the sake of a goal (to obtain more light or water) or for a certain purpose (e.g. to facilitate pollination). But these goals and purposes are not goals and purposes of the plant. The teleological behaviour of plants is explicable in non-teleological terms (Hacker, 2007, p. 131).

The above suggests that, contrary to appearances, the functions of organisms should not be taken as something that manifests a teleological behavior. Castelfranchi fully agrees with this assumption. He argues that, in a sense, any organism's behavior, as such, is seen as driven by a teleological process. For example, we could say that plants need light energy, among other things, for photosynthesis. Anyway, this natural process is not a goal proper, rather it is a *pseudo-goal*. These are merely *effects* or *outcomes* that have been selected by evolution to maintain a certain behavior that turns out to be efficient in terms of species survival. Within Castelfranchi's theory, the term 'pseudo-goal' generally refers to a "functional procedure that is implemented when the system receives a particular (either internal or external) stimulus. The system has been designed (by evolution or by a designer) to respond to the stimulus with a certain behavior" (Miceli & Castelfranchi, 2017, p. 70). We could say that biological needs, like the need for water or food, have as outcomes pseudo-goals. Biological needs are paradigmatic examples of absolute needs (McLeod, 2014). Now, absolutists are willing to accept that needs could be related to outcomes, as in the case of biological needs (McLeod, 2015). Pseudo-goals do not represent entities on which needs ontologically depend. For instance, if plant's need for solar energy was ontologically dependent on photosynthesis (pseudo-goal), then because of the asymmetry of ontological

dependency (necessarily x exists if and only if y exists and not *vice versa*), the photosynthesis process could exist without the need for solar energy, which would be totally pointless[11]. In summary, pseudo goals are outcomes of absolute natural needs' satisfaction itself.

Differently from pseudo-goals, *goals proper* are mental representations of expected outcomes that teleologically drive agents' behavior[12]. Mental representations can be of any format, either related to bodily perceptions or more abstract and symbolic (Miceli & Castelfranchi, 2017). It is worth noting that unconscious goals are still goals to the extent that they are represented "in one format or another, in some memory buffer, but are outside the system's consciousness" (Miceli & Castelfranchi, 2017, p. 70). In this regard, Castelfranchi uses the word 'goal' as a general category that includes different mental states that have a potentially conduct-controlling character over the behavior, including desires, needs, hopes, intentions. A goal arises every time an agent registers a *discrepancy* between the current state of the world and his mental states. In other words, agents attempt to modify the world acting according to their mental states. For example, if Giovanni desires to build a wall at a time 't', this means that the wall has not yet been built before that time. It is interesting to note that pseudo-goals can become goals proper, translating a biological function into a mental representation (Miceli & Castelfranchi, 2017, p. 70). For instance, if an agent had a mental representation expressed by the sentence 'I need some sleep', the

[11] Cfr.(McLeod, 2015, p. 23).

[12] It is interesting to note that there is a certain resemblance between the distinction of pseudo-goals and goals proper proposed by Castelfranchi on the one hand and the distinction between proper functions and derived functions suggested by Ruth Millikans'(1984, 1989) teleological theory of mental content on the other hand (I thank Alberto Voltolini for pointing such parallelism out). However, these distinctions don't seem to express exactly the same concepts. According to Millikan (1989), a proper function of an object x is what x is supposed to do (e.g. the function of lungs is transferring oxygen into the blood supply). Biological mechanisms have proper functions as a result of their evolutionary history. Generally, the function f of an object x explains in part the existence of x from an evolutionary perspective: the token x related to a certain type y exists today because y had a certain function f helpful in terms of specie's survival. Furthermore, very roughly, an object x may have derived functions in virtue of the proper functions of the mechanism that produces x. For instance, the functions of a mental state are derived from the proper functions of the biological mechanism that produces them. For what concerns desires, for example, such mental states have the derived functions of bringing about the desired state of affairs. Now, we can see how the notion of 'proper function' is quite similar to that of 'pseudo-goal'. In fact, both appeal to functions or functional procedures that have been selected by evolution to explain the existence of something efficient in terms of specie's survival. Yet, the notion of derived function seems to be different form that of goal proper. Derived functions come into play to provide a naturalistic account of mental states and their contents on the basis of certain biological mechanisms and their proper functions (cf. Kingsbury, 2006). On the contrary, the theory of goals proper draws attention to internal mental representations that intentionally drive agents behaviuor when such agents register a discrepancy between the current state of the world and their mental states. In this regard, goals proper are placed in contrast with pseudo-goals, being these latter responses of organisms with respect to certain stimuli. In other words, the difference between pseudo-goals and goals proper higlights the difference between acting 'mechanically' (i.e. responses to certain stimuli) and acting intentionally.

biological function of sleeping would be translated into a goal proper, a goal that the agent would like to bring about performing a certain action.

This being said, ontologically speaking we suggest distinguish between absolute and instrumental needs according to the two notions of goals that we have just introduced, namely needs that are related to pseudo-goals on the one hand, and needs that are ontologically dependent on goals proper on the other. The former corresponds to absolute needs while the latter to instrumental needs. In doing so, we attempt to clarify two concepts of 'goal' that, as McLeod (2015) has pointed out, are often implicitly used in the literature about needs. We believe that the proposed criterion of differentiation between needs, which is based on the clear conceptual demarcation between pseudo-goals and goals proper, could help to better identify, from time to time and consistently with theoretical positions that we have discussed so far, which needs that should be classified as absolute and which as instrumental.

Supporting the idea that some needs (e.g. biological needs) are related to pseudo-goals is tantamount to say that not all needs are ontologically dependent on goals proper, contrary to what is claimed by instrumentalists. Therefore, we agree with absolutists in this respect. In any case, we have to make one thing clear. As we said earlier, agents are able to translate pseudo-goals into goals proper, for example when a starving person says 'I need some food'. In this case, the need claim assumes the typical absolute form 'A needs X', where 'X' stands for the goal proper 'getting food' and this goal is conceived of as an end goal in itself. However, even if a pseudo-goal can be translated into a goal proper, the related need does not ontologically depend on the latter. It does not make sense to hold that the need for food, or whatever biological need you like, depends for its existence on a goal proper, which is in this case 'getting food'. In fact, the biological function of food would exist even if the agent was not able to mentally represent this function and, by doing so, translate it into a goal proper. Cognitively speaking, pseudo-goals can become goals proper. Nevertheless, from an ontological point of view, a pseudo-goal remains such.

Moreover, we underpin that biological needs are the only kind of absolute needs. In other words, 'absolute need' is synonymous with 'biological need'. In this, we diverge from absolutists that do not equate 'absolute' with 'biological' needs[13]. The reason why we affirm

[13] For example, McLeod suggests that it may well be plausible that there are some absolute needs "that stem from their status as persons (in a more or less Kantian sense)(2015, p. 26)". Unfortunately, he doesn't provide any clear examples of such needs; on the contrary, McLeod appeals to biological needs when it comes to explaining what are absolute needs arguing that such needs are ontologically independent of psychological factors (McLeod, 2014, 2015). In any way, we can assume that if there were absolute needs related to the status

that absolute and biological needs are the same thing lies in the fact that only biological functions are related to pseudo goals, thus are not ontologically dependent on mental representations or goals proper that teleologically drive our behavior. Instead, every time that needs are ontologically dependent on goals proper, they should be interpreted as instrumental. This also applies to claims of needs that, although being instrumental, apparently take the form of absolute needs, like 'I need $ 200', 'I need to wash my hands', 'I need to talk to you'. As we already know, these claims are expressed elliptically, that is without explicitly declaring goals on which needs depend. Absolute or biological needs are universal, in the sense that they concern all living creatures (besides, a living being could not have existed without having them), while instrumental needs pertain only to cognitive agents equipped with mental representations. Although absolute needs are obviously relevant to everyday life, we will limit our analysis to instrumental needs, since these are the most helpful for designing PA's services.

Let us remind that the first thing to be noticed talking about needs is that: we have to distinguish a *need as such*, which is a mental state like desires, beliefs, hopes, etc., from *what is needed*, that is the satisfier, a resource (object or action) that has the function of satisfying a need[14]. Thus, for instance, if Giovanni needs to take the car to go to Rome, we should distinguish between Giovanni's mental state of need on the one hand, and the car (satisfier) on the other. In this example, Giovanni entertains a mental state of need that is 'directed' or is 'about' a certain entity, namely 'the car'[15]. But what does it mean that a mental state is about something?

Answering this question means analyzing the relationship that exists between agents' minds and the world, namely taking into consideration the issue of intentionality and mental attitudes. We will discuss these topics in-depth in the next chapter. Before moving forward, we would like to make a few final considerations. First of all, as we have seen, scholars such

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of 'person', they would be closely linked to universal human rights, such as rights to education, work, liberty, etc. But the notion of 'universal human right' is a normative concept, that has its roots in the historical and juridical fields. So universal human rights and the corresponding (alleged) absolute needs can hardly be separated from the human cognitive dimension. Therefore, we expect that such kinds of needs are instrumental, that is, dependent on valuable goals to achieve to ensure the respect of human rights.

[14]Analogously, a desire should be distinguished from what is desired, an intention from what is intended etc. More generally, every mental state should be distinguished from the entity toward which that mental state is directed.

[15] You may be wondering if Giovanni needs a particular car (e.g. his car) or just 'a car', meaning 'whatever car'. Ontologically speaking, in the event that the object of thought was denoted by the locution 'a car', it would be possible to assume that such an object is an *incomplete object* à la Meinong. However, as we shall see in chapter four, we will hold that, in such a case, the object of thought is not an incomplete one, rather it is a particular object among a set of objects that satisfy conditions expressed by a certain concept.

as Doyal and Gough and Castelfranchi explicitly conceive of needs as instrumental goals, that is we must obtain what we need before and for obtaining what we aim at, where the modal verb 'must' here stands for 'is necessary'. The previous example 'Giovanni needs to take the car to go to Rome' highlights that 'taking the car', which is the need's satisfier, is a sufficient condition to go to Rome. However, 'taking the car' is not a necessary condition to achieve Giovanni's end goal, which is indeed 'going to Rome'. In fact, Giovanni could decide to go to Rome either by car or by train, that is to say, different satisfiers. Now, let's take the example 'Laura needs to hold the Green Card to work and live permanently in the U.S.A'. In this case, 'holding the Green card' is the only possible satisfier to reach Laura's end goal, which is 'work and live permanently in the U.S.A'. For one thing, the latter example is similar to the former, as both show a means-end framework; in other words, both are examples of instrumental goals. For another thing, while the former example implies only a *sufficient condition* to the end goal's achievement, the latter implies a *necessary and sufficient condition*. From this follows that there are two kinds of instrumental goals whose structure depends on the relationship between needs and satisfiers, that is: on the one hand, we have instrumental goals that require satisfiers that are sufficient for realizing end goals[16]. In addition, there are instrumental goals that require satisfiers that are, besides sufficient, also necessary for realizing end goals. This seems to capture our common-sense distinction between saying 'I need to do x, y or z to obtain w', namely x, y or z 'could be of help', and 'I need to do x to obtain w', the latter conveying a stronger message and an implicature, that is 'I cannot do without it' where this locution expresses the meanings of words such as 'necessity' or 'indispensable' or 'urgent'[17]. So the notion of necessity, which is used as a synonym for need, is conveyed, among other things, by the strong logical constraint related to instrumental goals that require necessary and sufficient satisfiers. Moreover, the concept of necessity, as Castelfranchi (1998, p. 57) has stressed, is also related to negative perceptions, feelings or emotions which are linked to needs.

This is a very interesting point that deserves attention because it sheds light on an issue that we have previously left in the shadows, that is, the question of harms related to the definition of absolute needs *à la* Wiggins, namely absolute needs are those needs the non-satisfaction of which implies harm. But, as we mentioned in section 1.1., we believe that 'harms' fall outside the ontological definitions of needs, they are just consequences of unmet needs

[16] As we shall see, this sense of 'instrumentality' not only refers to needs but also to desires.

[17] As far as we know, up until now this distinction between kinds of instrumental goals has not been critically analyzed within the literature about needs.

(being them absolute or instrumental) based, for example, on physical negative perceptions. In this respect, it is one thing to define needs, but quite another to define negative perceptions that can be associated with needs[18]. McLeod (2011, pp. 214–220) casts doubt on the so-called 'phenomenological thesis', denying that "a person can know his or her own needs by feeling them". He suggests that we should distinguish between a *need* and the *experience* of it. For instance, when someone says 'I need a drink', they don't feel the need for a drink, rather they feel thirsty. A need can be indirectly manifested by means of a feeling, but the *need is not itself a feeling*. So the need's necessity could be due to a kind of physical urge which is ascribable to a need's perception, rather than to the need itself. Furthermore, note that, from an instrumentalist point of view, satisfiers are resources and, like all resources, they are limited and require an effort to be acquired. If the satisfier is not reached, then the related need is not satisfied, and the agent's expectations about the goal are frustrated. We suggest that the avoidance of such frustration represents another reason that explains why needs are especially urgent (Biccheri & Ferrario, 2019).

[18] Note that even if we defined 'harms' in more abstract terms, for example, as being fundamentally disabled in the achievement of one's goals (Doyal & Gough., 1991), the substance would not change. Even so, harms are still consequences of unmet needs, rather than essential properties of needs themselves. Although the notion of harm is not relevant from an ontological standpoint, it is pivotal morally speaking. Definitions of harms provide a parameter to prioritaze needs: the more an unmet need implies harm, the more such need is morally relevant.

2. Intentionality and intentional objects

2.1 What does thinking mean?

This section and the next one aim to present some basic concepts of the theory of intentionality. Those without any background in philosophy of mind may want to read them straight through before reading the rest of this chapter. Readers already familiar with the theme can skip to section 2.3.

In contemporary philosophical literature, reams of paper have been written on the notion of 'intentionality', also known as *directedness* or *aboutness*, which is generally defined as that particular kind of property that some, if not all, mental states instantiate, namely the property of *being about*, to *represent* or *stand for* something, i.e. *intentional objects*. Although there are different types of mental states (e.g. beliefs, desires, hopes, perceptions, emotions, etc.), they all share the property of intentionality, which somehow links them to their intentional object (e.g. if Maria loves Luigi, then 'Luigi' is the intentional object of Maria's intentional state of love). The concept of intentionality lies on the simple intuition that *thinking* means thinking about something, in other words, if there were no *objects* of thought, there would not be thoughts at all, in still other words thinking is, first of all, a matter of *objectual attitude* or reference to objects.[19] Anyway, not all mental states seem to be intentional, that is to say, 'mental life' is not reducible to intentionality. Take a mental state of depression. It is certainly true that, for example, Maria could be depressed because of the loss of a loved one. In this respect, Maria's mental state of depression would be, among other things, about memories and feelings related to the deceased person or, more generally, about the deceased person himself; in any case, there would be something which mental state is about. Nonetheless, as Searle (1983) has pointed out, the depressed mood is not necessarily about a particular object, someone might be depressed or unhappy without any particular reason. Since depression, as well as other feelings such as pain, euphoria, panic, are mental states and, at the same time, do not seem necessarily be directed to objects, some philosophers argue that it is not true that all mental states exhibit the feature of intentionality. On the contrary, the thesis that all mental states are intentional stretches back to Brentano's theory

[19] We will talk about objectual attitudes later.

about the nature of mind. In *Psychology from an Empirical Standpoint* (1874) Brentano reintroduces the scholastic term 'intentio' as the distinctive feature of the realm of mental phenomena as opposed to physical ones. Brentano's proposal represents the starting point of the contemporary debate about intentionality, which has been declined in several ways, crossing with different themes within disciplines such as Philosophy of mind, Philosophy of language, Ontology and Cognitive science. In short, the investigation of the philosophical and scientifical nature of intentionality requires different research perspectives about different (although often strictly related) topics, including intensional contexts, consciousness, self-consciousness, the relations between the mind and the brain, mental representations, the epistemological disagreement between first-person knowledge and third-person knowledge, perception and agency, intersubjectivity, intelligence systems, social ontology (Cfr. Moran, 2013). Having said that, it must be emphasized that, although in this chapter we will touch on some of the above-mentioned topics, our focus will be exquisitely on a specific subject, that is the *metaphysical problem* of intentional objects, which might be stated as follows: *what is it to be an intentional object*?[20]

There is currently no consensus about the metaphysical status of such objects. It could be argued that mental states are about very different kinds of objects, for example, ordinary objects, properties, abstract objects. Besides, even nonexistent and impossible objects might be mental states' intentional objects (in literature, classic examples are Zeus, Pegasus, the golden mountain, the round square, etc.). This leads Tim Crane to suggest that an intentional object is not a particular kind of metaphysical object among others, since as long as something is the 'object' of a mental state, every kind of entity counts as an intentional object. In other words, intentional objects are not a genuine metaphysical category to be included in the ontological inventory, in Crane's words (2001a, p. 16) "they have no nature of their own". Now, as we will better see, our position on intentional objects is akin to Crane's suggestion. In fact, we assume that, inasmuch it is an object of thought, every kind of object 'counts' as an intentional object. In due course, we shall suggest that, with respect to a certain kind of object, 'being an intentional object' is nothing but playing a certain *role*. While the notion of role has been widely discussed within sociology and knowledge

[20] Note that, insofar as it is possible to make a distinction between metaphysics and ontology (where the former is an analysis that aims at defining objects from a conceptual point of view, the latter concerns the further question of the 'existence' of objects, in other words, whether there are such objects) the metaphysical problem, that is 'what is to be an intentional object?', is independent of the ontological one, namely 'are there intentional objects?'. The difference between metaphysics and ontology will be discussed in more detail later in the 3rd chapter.

engineering, it has been quite neglected in philosophy, except for the domain of formal ontology (cf. Bottazzi, 2010, p. 81).

In order to introduce our theory of intentional objects as roles, we need first to take better into account the concept of intentionality, acknowledging some established philosophical considerations about it [21]. Thereafter, we shall highlight some implicit assumptions concerning the individuation of intentional objects while providing a general overview of some of the most relevant theories dealing with such objects.

To begin with, intentionality has to be distinguished from similar words like 'intention' and 'intension'. The former term is part of the theoretical framework of folk psychology and can denote both an *action* and a *mental state*. In the first sense, we can *do things* with or without intention. For example, when someone claims 'I did not mean to hurt you' is just saying that they did something *unintentionally*, which is evidently different from performing the very same action *intentionally*, which would be, we might say, synonymous with 'deliberate action'. Intentional action presupposes, so to speak, *making choices* among possible alternative courses of action. Secondly, an intention can be a *mental state* that involves a kind of *commitment to ourselves* concerning the performance of *future actions*, like when Maria says 'I intend to attend Harvard University'. Note that having an intention to perform a certain future action does not necessarily guarantee that such action will be performed. For instance, Maria could drop out of her commitment to attend Harvard because of contingent facts (e.g. she runs out of money, Harvard rejects Maria's application, etc.) or, more simply, because she changed her mind: she doesn't want to attend Harvard anymore. The relation between intentional actions and intentions *qua* mental states, which represents a core element of *rational plans*, has been carefully analyzed by Michael Bratman (1984). We will take into consideration Bratman's theory of intention further on, for the time being, it is sufficient to keep in mind that an *intention*, conceived of as a mental state, is just one among many states, such as beliefs, desires, perceptions that exhibit the property of *intentionality*. In this respect, Maria's intention to take the bus on Monday at 7:00 A.M is a *mental state about* an intentional object, presumably an event, that is 'taking the bus on Monday at 7:00 A.M'. Furthermore, we should be careful not to confuse *intentionality* (with a 't'), the property of mental states that is the subject of this chapter, with *intensionality* (with a 's'). The latter locution comes from the word 'intension', the meaning of which is usually introduced in comparison with the term 'extension'. The distinction intension/extension, which dates back

[21] In doing this, we will refer especially to Voltolini's works on intentionality (Voltolini, 2005, 2006; Voltolini & Calabi, 2009; Sacchi & Voltolini, 2012).

to medieval logic, applies to linguistic expressions. While the *intension* can be seen as the meaning of a linguistic expression, the *extension* is the thing or the set of things designated by such expression (Bealer, 1998). Besides, different intensions might refer to the same things. Thus for instance, 'The big apple' and 'The city that never sleeps' are two definite descriptions whose intensions designate the same thing, that is New York, whereas 'The scariest movies of all time' expresses an intension that refers to the set which consists of the scariest movies of all time indeed. Now, what is the link between *intensionality* and *intentionality*?

Sentences consisting of *intentional* verbs, such as to believe, to desire, to know, to hate, etc., involve the so-called 'intensional contexts', where two well-known logical principles, differently from extensional contexts, are infringed, that is:

- Principle of existential generalization

$$\frac{P(a)}{\exists x(Px)}$$

- Principle of substitutivity of identicals *salva veritate*

$$(b = c \wedge Q(b)) \rightarrow Q(c)$$

The former principle says that from the fact that 'a' denotes, within the domain of discourse, an object that has the property 'P', we can infer that there exists something with that property. The latter principle states that if 'b' and 'c' denote the same object (i.e. b = c) and 'b' has the property 'Q', then we can infer that also 'c' has the property 'Q'. This means that linguistic expressions with the same reference can be substituted one with the other without changing the truth-value of the context in which they occur. Now, according to the principle of existential generalization, if the sentence 'The dog is sleeping in the garden' is true, we can infer that there exists something that is sleeping in the garden. But if the sentence 'Marta believes that the dog is sleeping in the garden' is true we cannot infer that there exists something that is sleeping in the garden. In fact, despite Marta's belief, the dog could be awake or been kidnapped, etc. Moreover, following the principle of substitutivity of identicals, if the sentence 'Cary Grant never won an Oscar' is true, then 'Archibald Alec Leach never won an Oscar' will be true, since both names 'Cary Grant' and 'Archibald Alec Leach' denote or refer to the same person. The substitution of co-referring terms does not

affect the truth value of the sentence in which they occur. Yet, suppose that the sentence 'Marco believes that Cary Grant never won an Oscar' is true. From the truth of this sentence, we cannot infer that the sentence 'Marco believes that Archibald Alec Leach never won an Oscar' is true, given that Marco could know who Cary Grant is and, at the same time, not know who Archibald Alec Leach is. Moreover, according to the *principle of compositionality*, the truth value of a complex formula is determined by the truth value of the atomic formulas that compose it and by the compositional rules. Contexts in which the principle of compositionality holds, like extensional contexts, are said to be truth-functional. Thus, for example, the truth value of 'Adam is a lawyer and Sally is a scholar' depends entirely on the truth values of 'Adam is a lawyer' and 'Sally is a scholar' and on the rules concerning the logical connective 'and', which are such that the complex formula will be true if and only if both atomic formulas are true, otherwise it will be false. Yet, the truth value of the sentence 'Maria believes that Adam is a lawyer and Sally is a scholar' could be true even if 'Adam is a lawyer' is false or 'Sally is a scholar' is false or both are false. So, as we can see, intensional contexts are not truth-functional. The failure of the abovementioned logical principles in intensional contexts ultimately depends on two different perspectives, that is first-person knowledge and third-person knowledge about the content of mental states that are expressed through sentences (cf. Bonomi, 1983, p. 193). Let us try to understand better how these perspectives differ.

As is well known, when intentional verbs are followed by a 'that-clause' reporting full sentences, we get *propositional attitudes*, since intentional verbs express a (mental) attitude to propositions, or rather, are said to have *propositional contents*. Propositions identify truth conditions under which mental states are generally fulfilled or unfulfilled, depending on whether propositions are true or false respectively. More precisely, it is customary to hold that propositions are truth-bearers, while sentences are true when expressing true propositions. Let us consider now the sentence a) 'Mario believes that John Coltrane was an American saxophonist', where the intentional verb 'believes' expresses an attitude with respect to a certain proposition which is expressed by a content-sentence b) 'John Coltrane was an American saxophonist', which is embedded in a). As Perry (1995) underlines, the utterance of a sentence like b) in itself would just assert the truth of its proposition that represents, so to speak, *how things are in the world* from a third-person knowledge. So we can easily establish the truth of b) regardless of what Mario, the subject of the sentence a), is believing about b). We can also note that in as much as b) is part of a), its function is just to *report what the subject believes*, and this obviously rests upon the subject's first-person

knowledge, that is what the subject believes to be true or false. Thus within intensional contexts, we have to deal with a possible gap between *what is true or false* from a third-person knowledge, and *what is believed to be true or false* from a first-person knowledge. That being said, the relationship between intentionality (with a 't') and intensionality (with a 's') remains unclear. Some philosophers have attempted to explain this relation ending up mixing *de facto* the two things. This is the case of Roderick Milton Chisholm. The failure of existential generalization, together with the failure of the principle of substitutivity of identicals and the infringement of the principle of compositionality, roughly correspond to the three criteria suggested by Chisholm (1955, 1957) to provide necessary and sufficient conditions that define the concept of intentionality (with a 't'). But then that means that Chisholm attempts to identify intentionality, a property of mental states, resorting to criteria that apply to linguistic expressions, and in doing so he actually defines intentionality in terms of intensionality (cf. Gozzano, 1997). At any rate, Chisholm's linguistic approach to intentionality has been criticized since the three criteria turn out to be neither necessary nor sufficient conditions for intentionality. Even if Chisholm has attempted to refine his theory in the face of criticism[22], the linguistic approach only proves sufficient condition not to define intentionality, but to characterize intensional contexts (cf. Voltolini & Calabi, 2009). Spelling out the problem of the relation between intensionality and intentionality is far beyond the scope of this dissertation, suffice it to say that intentionality does not seem to be reducible to intensionality, given that intensional contexts include not only intentional verbs but also modal expressions like 'it is necessary that', 'it is possible that' (Alethic modality) and 'it is obligatory that', 'it is permitted that' (Deontic modality). In any case, the linguistic approach, despite its methodological limitations, has the merit of shedding lights on the close relation between intentionality and intensionality, but most of all can be read, albeit indirectly, as a doorway to the individuation of the actual salient features of the concept of intentionality (cf. Voltolini, 2005). According to Crane (2001a, p. 21), the failure of the existential generalization could be interpreted as the expression of the fact that the intentionality of a mental state *is independent of the existence of its objects*, i.e. it can be about existent objects as well as nonexistent objects: being scared of Samuel Little (the most prolific convicted serial killer in United States history) does not differ much from being scared of Boogeyman (the mythical creature that frightens children). In point of fact, the mental state of fear is always the same, what changes are mental state objects. It could be

[22] See (Chisholm, 1967a, 1967b).

argued that, actually, there is a big difference from fearing Little and fearing Boogeyman, since the former exists, unlike the latter, so the former is potentially a 'real danger'. Anyway, if you did not know that Boogyman does not exist, you would probably be pretty scared of it, you would feel a real danger, trivially that's why horror stories succeed in terrifying children who are frightened more than adults should be. Moreover, Crane (2001a, p. 21) puts the failure of the principle of substitutivity of identicals in terms of the *aspectual shape* of intentional states. The object which the mental state is about is always presented in a certain way, that is from a certain point of view. We can think about the very same object time as 'Joe Biden' and another as 'The current president of the U.S.A'; this obviousness is what Searle (1992, p. 155) calls the 'aspectual shape' of intentionality. Thus the possibility for mental states to be about nonexistent intentional objects and the aspectual shape would be the main features that identify the intentionality of mental states. The contemporary debate on intentionality has been developed in an attempt to find answers to issues raised by these features, which should mean the latter are supposed to grasp something that is part of what defines intentionality itself or, at the very least, as it has been historically thought so far.

Once that the basic considerations on intentionality have been clarified, it is time to introduce a core point related to intentional mental states, namely the difference between *propositional* and *objectual attitudes*. Mental states which are related to propositional content are called, as we have already said, propositional attitudes. For example, 'Paul believes that the Sun is a star', 'Bill desires that his son passes the exam' are mental attitudes where 'believes' and 'desires' are attitudes directed to a proposition. To be fair, holding that propositional attitudes are 'directed to' or 'are about' propositions would be quite wrong, since it would implicitly imply that propositions are propositional attitudes' intentional objects. This observation is not trivial, given that one thing is to say that a) 'Maria believes that 2+2 = 4', but saying that b) 'Maria believes the proposition that 2+2 = 4' is a whole other thing. In fact, concerning a), '2+2 = 4' is the *content* of the attitude, more precisely a propositional attitude, whereas with respect to b), 'the proposition that 2+2 = 4' is the *intentional object* of the attitude, which is not a propositional attitude (cf. Grzankowski, 2016). Thus it would be better to define propositional attitudes as attitudes *having* propositional contents. Many mental states are not described in propositional terms[23]. For example, 'Maria fears

[23] The distinction between propositional and objectual attitudes has been rejected by Propositionalism, which might be defined as the thesis that all intentional mental states entail relations to propositions or something proposition-like. For a critical view about this thesis see (Montague, 2007).

Boogyman', 'Paul likes potatoes', 'Jenny loves Paris', 'Peter fears trolls', and so on, are non-propositional attitudes[24], in fact, they are *objectual attitudes*. But what is the difference between these kinds of attitudes?

Propositional attitudes *are sensitive* to the truth of their contents, that is there are certain *extra-mental conditions* under which propositions can be true or false. For instance, if Maria believes that one molecule of water is composed of two hydrogen atoms and one oxygen atom, then Maria's mental state proposition is true according to chemical laws. When propositions are true, then beliefs, desires, perceptions toward these propositions are said to be accurate, satisfied, veridical, respectively. As we already said, it is customary to hold that propositions are truth-bearers, while sentences are true when expressing true propositions. Furthermore, *states of affairs* usually play the role of propositions' *truthmakers*, that is, very roughly, entities in virtue of which propositions are true. However, Simons (2009) has stressed that also *tropes*, and those specific kinds of tropes that are *events*, can play the role of truthmakers. The relation holding between truthmakers and propositions is called 'truth-making', and different truthmakers can make the same proposition true. Instead, *objectual attitudes* are not involved with the truth-sensitive matter. For example, if Maria believes in God it seems not sensible to ask in what circumstances Maria's attitude is veridical.

The difference between these kinds of attitudes roughly reflects Kim's (1996) distinction between *reference intentionality* (RI) and *content intentionality* (CI), where the former has to do with *objectual attitudes* and the latter with *propositional ones*. Relating to intentional mental states properties, RI is the property of being 'directed upon' or 'being about' an intentional object, which has to be distinguished by a similar property, that is CI, namely the property of 'having a content' (more precisely a *propositional content*), where such content is what makes an intentional mental state semantically valuable, in other words, what makes such state true or false (cf. Voltolini, 2006). With this distinction on the table, the very concept of intentionality undergoes further refinement. On the one hand, as we have discussed so far, intentionality can still be seen as the mental states' property of being about

[24] Note that objectual attitudes can differ, from a syntactical standpoint, depending on whether they are formulated with singular or general terms. Singular terms, that is proper names or definite descriptions, refer to an individual object. For example in 'Jenny Loves Paris', 'Paris' is a singular term. Instead, in 'Paul likes potatoes', 'potatoes' is a general term that does not denote a particular object. General terms as 'a beer', 'a man', etc. are called 'indefinite descriptions', see (Heim, 1982). In philosophical literature on intentionality general terms are related to the metaphysical status of indeterminate or incomplete objects. As we shall see, such objects are either accepted as particular kinds of objects within theories *à la* Meinong or simply rejected by philosophers that are ontologically committed only to existent objects. A third alternative is attempting to give a reductionist account of incomplete objects, that is "On the reductionist way of thinking, what it is to have an unspecific object as the object of your desire is for your desire to have a certain nature: that it is the kind of desire that is satisfied by a thing of a certain kind" (Crane, 2013, pp. 131–133).

an object (RI), on the other hand, this property is flanked by another property of mental states, namely CI, which makes a mental state a state that *something is the case*. If we look more cloosely at the property of CI, we will realize that the propositional contents of mental states are strongly related to the truth conditions, also known as conditions of satisfaction, of such mental states. As Voltolini explains:

> Saying that a mental state is semantical valuable entails saying that it is true, or more generally satisfied, under certain (extramental) conditions; these are the conditions which must be fulfilled so that such state is true or, more generally, satisfied. For instance, the belief that Vercelli is west of Milan is true only to the extent that - if and only if, as it's said – Vercelli is actually due west of Milan (Voltolini & Calabi, 2009, p. 10; my translation).

The propositional content ascribable to CI identifies the conditions of satisfaction related to the mental state which has such content, the conditions that must be fulfilled to make the state satisfied. As we said, states of affairs are typically deemed to be the entities in virtue of which propositional contents are true. Note that intentional mental states can have propositional content independently of the subsistence of the related states of affairs. For example, Maria might believe that John is a faithful husband, but that doesn't mean that he actually is. The *independence of intentional mental states from the subsistence of states of affair*s can be considered another property of intentionality, which is in addition to the other two properties abovementioned, that is the possibility for mental states to be about nonexistent intentional objects and the aspectual shape. More exactly, while the former property qualifies CI, the latter two properties characterize RI. It is worth noting that RI is, at least, a necessary condition for CI (cf. Voltolini & Calabi, 2009, pp. 9–17). In this respect, we cannot have an intentional mental state that something is the case, without first having such a state about something. For instance, John cannot believe that New York city's current tallest building is One World Trade Center, without having a mental state of RI directed to that building.

Having said that, in this chapter, we shall take into consideration only RI, the property of mental states of being about intentional objects. Before considering the way in which RI has been employed according to different theories about intentional objects, it would be good taking a look at the very philosophical notion of object.

2.2 Three senses of object

In the contemporary philosophical literature, there are at least three main senses that characterize the word 'object', that is: a) Object as the broadest category under which

everything falls; b) Object as an *ordinary* entity; c) Object as a *particular* entity. Starting with a), the term 'object' here is a good candidate, alongside other words including *thing*, *being*, *existent*, *entity*, *item*, to represent the most general metaphysical concept (cf. Rettler & Bailey, 2017), that would amount to just saying that *everything* is an object, which is not very informative. Defining such a concept is not an easy task, but maybe it is not even necessary to do so. First of all, this notion is hard to outline because it is too inclusive, or better, the most inclusive metaphysical notion. We can analyze the point in terms of *summum genus*. It is possible to intuitively grasp the meaning of such conception of object resorting to Twardowsky's theory, where the *summum genus* is "that something to which no other concept is superordinate" (Raspa, 2006, p. 49). In this respect, we might conceive of the concept of 'object' as a primitive concept (e.g. the concept of point in geometry), that as such cannot be defined in terms of other concepts. On this line, Frege's logical objects would be primitive (cf. Rettler & Bailey, 2017), but logical objects are just a partition of *summum genus*, which instead would represent a sort of intuitive starting point for metaphysical reasoning in general and this would explain why the notion of 'object' (or cognate notions, such as thing, entity, being, etc.) is not very informative. Concerning b), ordinary objects are those related to our daily life experience, such as physical or material objects like cars, tables, trees, houses, people, etc. Finally, c) involves the notion of *substantial* conception of object, which is more inclusive than b). In Crane's words, the difference between b) and c) can be shown as follows:

> A very common use of the word 'object' is in phrases like 'physical object' or 'material object'. But there are many contexts in philosophy and elsewhere where we use the idea of an object in a different way. For instance, a question in the philosophy of mathematics is whether numbers are objects. This debate would be impossible to understand if the only sense we could make of the word 'object' is the sense it has in the phrase 'physical object'—since of course numbers are not physical objects. Sometimes numbers are called 'abstract objects', intended to suggest that they are not 'concrete', where concreteness is sometimes explained in terms of existence in space-time. This conception of an abstract object, like our conception of a physical object, is what we might call a *substantial* conception of an object. It is a metaphysical theory that there are these kinds of objects, with this kind of nature. This use of the term 'object' is not a pun or a homonym of its use in the phrase 'physical object': on many views, what makes abstract objects *objects* is (e.g.) that they are particulars, the referents of singular terms, or the values of variables bound by first-order quantifiers—things they have in common with physical objects (Crane, 2001a, p.15).

But how does the intentional object relate to the three senses of the word 'object' that we have just introduced?

First of all, as long as a) entails the notion of *summum genus* also the intentional object is included under it. Besides, according to Crane (2001a), if the intentional object was nothing but the object toward which a mental state is directed, given that we can think about the *summum genus*, then the *summum genus* itself could be an intentional object. This would not imply that the intentional object *per se* is the *summum genus*, rather this can be an intentional object as long as it is thought of.

With respect to b), it is easy to see how our thoughts are 'primarily' about objects placed in the context of our daily life experience. Following the analytic philosophical tradition, we can use the expression 'ordinary objects' as synonymous with '*middle-sized* objects', even if it should be stressed that the latter locution is not that straightforward:

> Philosophers at the beginning of the analytic tradition like Russell, Moore and Wittgenstein—explicitly included tables, chairs and hands in the class of mid-sized objects. This short list was, presumably, representative rather than exhaustive. In more recent analytic writing, the defining feature of a mid-sized object is that it can be picked out using unaided human sensory capacities. It isn't clear whether spectacles should count as sensory aids. If glasses are sensory aids, then what falls under the definition of mid-sized would seem to vary considerably from person to person. If glasses are not aids, then it isn't clear why the objects resolved by telescopes, microscopes and MRI should not qualify as mid-sized objects. Despite these unresolved questions the intuition that frames the concept of the mid-sized object is not optical resolution but that the mid-sized comprises those familiar objects encountered on a day-to-day basis in common human living (Foster, 2011, pp. 1–2).

In any case, the intuition would be that middle-sized objects are objects that are related to our daily life, objects that are, so to speak, 'ordinary', which basically are physical objects. Now, according to Searle (1979, 1983), intentional objects would be nothing but ordinary objects. However, as we have just seen in the abovementioned Crane's passage, it is possible to hold that there are objects, like abstract objects (but also properties, events, etc.) that, from a metaphysical point of view, are not objects in the same sense as ordinary objects. Nonetheless, we are able to think about them, regardless of their not being ordinary objects. Thus, as Crane (2001a) has outlined, the category of intentional objects, contrary to what Searle thinks, is not reducible to ordinary objects. But maybe with the expression 'ordinary object', Searle could just mean *existent objects*; in other words, something is an intentional object if and only if it exists. But what do we do with nonexistent objects like Sherlock Holmes, Boogyman, Zeus, etc.? Aren't they typical examples of intentional objects? Again, the category of ordinary objects does not exhaust the one of intentional objects. In a nutshell, this is Crane's metaphysical assumption (2001a, pp. 14–15) used to rejects Searle's conception of intentional objects as ordinary objects (1983, p. 117). Despite Crane's

criticism, as we shall see, theories *à la* Searle, that is to say, theories that are not ontologically committed to nonexistent objects, are still able to cope with intentionality puzzles.

The last sense of object is c), that is objects as *particulars* or *individuals*, which are usually metaphysically introduced as just opposed to another kind of metaphysical object, namely properties. More precisely, particulars might be distinguished from properties by means of the primitive relation of *instantiation*: particulars are objects that cannot be instantiated, that is they cannot be predicated of other objects, such as Bill Gates, the Empire State Building, the Mona Lisa, while properties are objects that can have instances, namely they characterize objects, like the property of being red or being a philosopher. Thus while the particular 'Nicolas Cage' is an instance of the property 'being an actor', Nicolas Cage cannot be an instance of himself. Within the philosophy of language, singular terms such as proper names and definite descriptions refer to or denote particulars. For example, the definite description 'The current President of the Italian Republic' denotes 'Sergio Mattarella'. Theories of mind of analytic philosophy have seen intentionality, or rather, referential intentionality (RI), above all in terms of a subject related to the linguistic matter of singular terms, that is how singular terms pick out or refer to their objects. Which is the relationship between reference intentionality and linguistic reference?

In everyday life contexts, when we are interested in understanding what is the reference denoted by a linguistic expression uttered by a speaker, we are primarily concerned with the question of identifying what the speaker means, that is, so to speak, what is on the speaker's mind. In this sense, 'what do you mean?' can be seen as synonymous with 'what are you thinking about?' (cf. Voltolini, 1992). Now, along this line, mental states' intentional objects usually are considered to be particular objects denoted by singular terms, for example, if John loves Mary, then the physical object denoted by the proper name 'Mary' corresponds to the intentional object. However, note that we can have intentional mental states that are not about particulars at all. Take the propositional attitude 'John believes that all men are mortal', here there seems not to be any particular man to which John's mental state is directed to. In this case, we might suggest that the intentional object, far from being a particular, is a *property*, more precisely two properties that are 'being a man' and 'being mortal', so we would have two distinct intentional objects. The sentence would express the concept that for every x, if x is a man then x is mortal (cf. Voltolini & Calabi, 2009, p. 13).

In addition, following a Meinongian approach, it is possible to hold that, contrary to Russell's theory of definite descriptions, a sentence like 'The golden mountain is golden' does not utter the existence of a golden mountain, that is a non-existent object (which would

entail a contradiction), given that the expression 'The golden mountain' embedded in the sentence is not a singular term which denotes a particular or individual, rather it is a *general term* that, according to Meinong, refers to an incomplete object, that is an object which is not qualified in all its aspects (Raspa, 2018b, pp. 69–70). In this sense, if someone had a mental state about the golden mountain, then his intentional object would be an incomplete object.

In conclusion, let us say a few words about how intentional mental states can be directed to complex entities, like for example states of affairs. The standard philosophical conception (Armstrong, 1997, 2004) assumes that states of affairs are complex entities that consist of particulars that instantiate or exemplify properties (i.e. universals)[25]. In this case, individuating intentional objects could be a tricky matter. For instance, with respect to the propositional attitude, 'Maria believes that Naples is the largest city of Southern Italy', we may claim that the intentional object of Maria's mental state is the very state of affairs 'Naples is the largest city of Southern Italy'. But one could argue that, actually, we can individuate two different intentional objects, that is 'Naples' and the property 'being the largest city of Southern Italy'. In any way, given that a state of affairs is made up of its constituents, holding so would be equivalent to saying that Maria's intentional state of belief is about the property 'being the largest city of Southern Italy' instantiated by 'Naples', namely the state of affairs 'Naples is the largest city of Southern Italy'. Hence it would be more accurate to say that Maria's intentional state is about the state of affairs *qua* complex entity. In this respect, what applies to states of affairs does also to *events* conceived of as *structured* particulars[26] *à la* Kim (1976), namely particulars that instantiate properties at a certain time (e.g. 'The first nuclear bomb explosion on August 6, 1945' is the event constituted by the particular 'bomb' which instantiates the property of 'being exploded' on August 6, 1945). Also in this case, we could say that our intentional mental states are about events *qua* complex entities.

[25] However, one could conceive of states of affairs as complex of tropes, or even complexes of substances and tropes. For a review on metaphysical and ontological perspectives regarding states of affairs see (Reicher, 2009).

[26] As Orillia (2008) has pointed out, there are two main perspectives about events concived of as particulars. On the one hand, we have the *structuralist* view, according to which, as we have said, events are particulars that exemplify properties at certain time. In such a case there would not be much difference between events and states of affairs concived of as complex entities. On the other hand, the *non-structuralist* view (see Davidson, 1980) simply interprets events as a basic type of particulars.

2.3 Theories of intentional objects

We shall now proceed to give a short introduction on the most prominent theoretical proposals about the origins of the metaphysics of intentional objects in the 20th century, that is theories related to figures such as Brentano, Twardowski, Husserl, and Meinong, briefly stressing how such theories have been interpreted by contemporary commentators. We should emphasize that this section is not intended to be a historical study in the interpretation of intentionality[27], but rather we are interested in underlining core concepts that continually recur in explaining this mental phenomenon, including different conceptions of intentional objects and contents, the locutions 'aboutness' 'directedness' and 'mental reference', relations among intentional mental states and objects as well as contents. This will enable us to compare and contrast widely accepted theories with respect to our approach to intentional objects at a later time. The goal is showing that, despite different senses of intentional objects, our metaphysical analysis, given certain conditions, might be applied to all those theories that conceive of intentionality as a relation between a mental state and an object. Note also that we have so far talked about *mental states* that instantiate the property of intentionality. However, it should be stressed that with respect to the early theories of intentional objects, philosophers were accustomed to use the term 'mental act', rather than 'mental state'. As Crane (2001a, p. 39) has pointed out, the expression 'mental act' is an old terminology that is basically equivalent to the locution 'mental event', which differs from a mental state in so far as the former is a *particular,* while the latter is a *property* which is instantiated by a particular. Furthermore, mental events are said to 'occur' or 'happen' in time, they have temporal parts, differently from mental states. We shall take into consideration this difference further on. For the time being, note that both mental states and mental events can have intentionality. The only difference is that mental events *qua* particulars can directly instantiate properties, while mental states *qua* properties can have intentionality as a property of property, that is to say as a second-order property[28]. So what we have commented on in previous sections relating to intentionality holds for both mental states and mental acts or events. Finally, note that most authors that we shall discuss tend to see a close relationship between intentionality and consciousness, presuming that mental acts come with phenomenal experiences. At any rate, analyzing this relationship needs not

[27] For historical overviews of intentionality and intentional objects see (Gozzano, 1997; Moran, 2013; Salice, 2012; Taieb, 2018).
[28] Note that if we did not see events as particulars, but rather as complex entities *à la* Kim, there would be no difference between mental events and mental states (cf. F. Orilia, 2008; Voltolini & Calabi, 2009).

detain us here, since to the extent that it is possible to think about intentionality as distinct from consciousness, we are allowed to take into consideration only the former concept. It will be sufficient to say that, as Kriegel (2003) has remarked, nowadays many philosophers hold that consciousness depends on intentionality, but few believe the converse.

This said, let's start our review on intentional objects with Franz Brentano, which is commonly thought to be one who has laid the basis for the contemporary debate on intentionality. Even if there are recurring themes in Brentano's philosophy, such as his Aristotelian inheritance and the conception of descriptive psychology as a discipline having ontological value (Smith, 1988), his theory of intentionality has changed over time, since while once he interpreted mental acts as relations to objects, in his later works he dropped this idea, retaining that mental acts are not relational at all. As it became customary among modern commentators, let us introduce Brentanos'early intentionality thesis quoting a celebrated passage from the *Psychology from an Empirical Standpoint* (1874):

> Every mental phenomenon is characterized by what the Scholastics of the Middle Ages called the intentional (or mental) inexistence of an object, and what we might call, though not wholly unambiguously, reference to a content, direction toward an object (which is not to be understood here as meaning a thing), or immanent objectivity. Every mental phenomenon includes something as object within itself, although they do not all do so in the same way [...] No physical phenomenon exhibits anything like it. We can, therefore, define mental phenomena by saying that they are those phenomena which contain an object intentionally within themselves (Brentano, 1874/1995, p. 68).

We can see how Brentano defines mental phenomena, contrary to the physical ones, as qualified by the intentional *inexistence* of objects. Nowadays this is known as 'Brentano's thesis'. It must be made clear that the thesis does not claim that such objects do not exist, rather the term '*in-existence*' is locative, it suggests where we 'have to look for' these objects, that is within the mind, or better, within the mental acts that are about them, in other words, they are *immanent* to mental acts (Jacquette, 2015). Besides, as Smith (1996) has pointed out, the locution 'reference to a content' and 'direction toward an object' might be interpreted as two ways of saying the same thing, given that Brentano does not distinguish, unlike his pupil Twardowski will do, between contents and objects, speaking indiscriminately of both. In any way, as we will see, Twardowski's distinction will be taken by Brentano himself in his later works (hereinafter we should be careful not to confuse the notion of 'content' with that of 'content intentionality (CI)' that we have examined in section 2.1 of this chapter. Let us remember that reference intentionality (RI) is what we are concerned with here, that is the property of being about objects. As we shall see, following Twardowski, many philosophers have attempted to distinguish between intentional objects

and contents, where the latter are conceived of, from time to time, as *psychological* or as *semantic* entities. Yet whatever the word 'content' is supposed to mean here, such content should not be thought of as a propositional content, that is the kind of content associated with CI (cf. Voltolini & Calabi, 2009)). As we have just said, Brentano holds that intentional objects are *in-existence objects* or *immanent objects*. We may wonder to what degree the concept of 'intentional in-existence of objects' might be somehow independent of the notion of 'direction toward an object', which is nowadays best known as *directedness* or *aboutness*. Well, there is really no simple answer. Spiegelberg (1994) maintains that given that Brentano will drop the scholastic thesis of the intentional in-existence at a later time, without however abandoning the thesis of aboutness, the very original Brentano's contribution to defining intentionality would be the latter rather than the former. Inasmuch as the notion of aboutness can still be used by Brentano to define intentionality without resorting to the intentional in-existence of objects, it goes without saying that the former concept is independent of the latter. On the other hand, Smith and McIntyre (1982) call attention to the fact that the intentional in-existence of objects entails that such objects are *mind-dependent* entities whose existence is immanent to mental acts and, at the same time, we cannot have, by definition, mental acts that are not directed to intentional objects. That basically means that the notions of intentional in-existence and aboutness are interdependent. Be that as it may, the problem of Brentano's early position on intentionality is that it seems to cut the bridge, in a manner of speaking, between the mind and the world, thereby falling into a strong form of idealism, given that every object perceived, desired, etc. is an object that exists only within a mental act. In other words, the very intentional object is a *constituent* or a *part* of the mental act itself, which can be seen as a mental event occurring at a certain time with respect to a specific subject. This implies, for instance, that different mental acts occurring at a different time will be constituted by different intentional objects. For example, the mental act of *desiring* a cup of tea and the mental act of *seeing* a cup of tea would be different acts not only because the former is an act of desiring that occurs at time t_1 while the latter is an act of seeing that occurs at t_2, but also because every mental act is literally constituted by its own intentional objects, which means that we would have two different cups of tea, that is one for the act of desiring and the other for the act of seeing. But intuitively the cup of tea that is located 'outside the mind', the physical object, should be the same. Besides, even two mental acts of the *same kind* occurring at different times, let's say acts of perceiving the Tour Eiffel, would be constituted by different intentional objects. All the more reason two different acts, related to two *different subjects*, would not share the same intentional object.

Therefore, apart from the conception of intentional objects as solipsistic or private entities, the immanent theory of intentionality has the drawback of multiplying indefinitely such objects (Jacquette, 2015). In any way, it has the advantage to be able to brilliantly deal with the problem of nonexistent objects, simply stating that objects like Pegasus or the golden mountain, rather than not existing, only exist within the mind. The immanent view will be rejected by Brentano himself during what is known as his later 'reist' phase. Brentano clarifies his position claiming that:

> It has never been my view that the immanent object is identical with "object of thought"(*vorgestelltes Objekt*). What we think about is the object or thing and not the "object of thought". If, in our thought, we contemplate a horse, our thought has as its immanent object—not a "contemplated horse", but a horse. And strictly speaking only the horse—not the "contemplated horse"—can be called an object. But the object need not exist. The person thinking may have something as the object of his thought even though that thing does not exist (Brentano, 1889/1966, p. 52).

As can be seen, Brentano distinguishes the *immanent object* from the *object of thought*. In Brentano's example, the immanent object is the horse itself, while the object of thought is the 'contemplated horse'. Here the most pronounced difference concerning Brentano's early position is that the *immanent object*, that previously had been interpreted as a *constituent part* of the mental act, thus as an object of thought, now seems to become a physical object. This is the only entity that now deserves to be called 'object'. But then why does Brentano keep referring to physical objects using the expression 'immanent object'?

A possible solution suggested by Jacquette (2015) is that: either Brentano uses the locution 'immanent object' meaning something totally different from 'in-existent object', or he is trying to employe Twardowski's distinction between content and object without properly understanding such distinction. Starting from a Brentanian framework, in the monograph *On the Doctrine of the Content and Object of Presentations* (1894), Twardowski introduces a precise distinction for discerning between the object of thought (*content*) and the *object itself* toward which the thought is directed. In Jacquette's words:

> The concept of the content of a presentation is already available to Brentano's immanence thesis, but from the standpoint of Twardowski's categories, Brentano confuses the content of a presentation with its object. The content only, and not the object of the presentation, is immanent, lived-through and contained within the psychological state to which the content belongs (Jacquette, 2015, pp. 29–30).

It should be briefly noted that, in the passage, expressions like 'object of presentation' and 'content of presentation' indicate a psychological phenomenon's experience. According to Brentano, every psychological phenomenon is based on a *representation*, that is a way in

which something is *presented* to consciousness with regard to subjects' mental acts. This is the most fundamental phenomenon upon which other two phenomena are grounded, that are *judgments* and *interest* or *emotion* (Kriegel, 2017). This said, besides Jacquette, also Albertazzi (1990) argues that Brentano would espouse Twardowski's distinction, applying it to a linguistic analysis which is basically focused on intentional objects as *als ob*, that is to say, a 'fiction' based on our ways of conceiving them. What is more, according to Haldane (1989), after having carefully considered relational aspects of intentionality, Brentano would have come to the point of rejecting such a view. Brentano's new conception of intentionality now would bring into play *monadic properties*. For instance, if John was thinking about Mary, there would not be any intentional relation between John's mental act and Mary, rather John's mental act would just instantiate the monadic property 'thinking about Mary'. In doing so, Brentano would prepare the way for what nowadays is called *Adverbialism* on intentionality, a theory where, with respect to a mental event, being intentional is nothing but *being modified* in a certain way. The mental event modification can be expressed by an adverbial mode of expression. For example, we might say that "thinking about dragons is just a matter of thinking dragon-wise and does not involve bearing any relation to dragons. More generally, representing x is a matter of representing x-wise rather than of bearing a representation relation to x" (Kriegel, 2008, p. 85)

Coming back to Brentano, resorting to monadic properties, he can cope once again with the problem of non-existent objects, since no actual relations to such objects are required. However, also the case of mental acts involving existent objects are explained with monadic properties, that is to say, here too, our thoughts are non-relational. So Brentano falls once again in a form of idealism that separates the mind from the world. To avoid this problem, Haldane (1989) reformulates Brentano's thesis maintaining the original intuition of intentionality as a relation to objects. According to him, the property of mental acts of being directed to objects, namely *aboutness*, might be split into two different properties: *directedness* (aboutness$_1$) and *mental reference* (aboutness$_2$). The difference between directedness and reference is that the former puts a mental state in connection with content, the latter links a mental state with an intentional object. As we know by know, the intentionality of a mental act is independent of the existence of its objects, i.e. we can think about existent objects as well as nonexistent ones. How shall we explain this fact from this perspective?

To answer this question, we should understand how directedness and reference interact. Regardless of the fact that the objects of mental states exist, we are able to cognitively grasp

something, namely a *contentful meaning*. Directedness is equivalent to *contentfulness* and pertains to every mental act. Having content is a feature that is independent of the existence of objects because, at least in some cases, there are no objects which we can refer to, but still our mental acts have content. Thus, if Maria fears Boogymen, then Maria's mental act is related by means of directedness to the content expressed by the term 'Boogymen'. Instead, when mental acts' objects exist, directedness has the 'power', so to speak, to identify a specific object, an intentional object, which we can refer to. For example, imagine that Paul admires Varenne, the best trotter of all time. In this case, it is in virtue of directedness that his mental act is related to an intentional object through a reference relation, because Varenne, among all existent entities, is the one which satisfies the concept expressed by the definite description 'the best trotter of all time'. So, it is in virtue of having content that mental acts can refer to objects, provided that such objects exist.

In the end, what are Brentano's intentional objects is a question that remains open but, despite interpretation difficulties, as is well known, he has had a great impact on the history of philosophy, directly influencing the works of philosophers like Twardowski, Meinong, and Husserl, who have developed their own proposals on the subject, formulating three original, although in some respect similar, theories of intentional objects. Let us now concentrate on Twardowski's notion of intentional object and up through the analysis of Husserl and Meinong.

As briefly said, in his work *On the Doctrine of the Content and Object of Presentations* (1894), Twardowski clearly distinguishes between contents and objects of mental acts, claiming four arguments to defend this distinction in the 6th paragraph of his work. The easiest way to grasp such distinction, suggested by Twardoswki (cf. 1894), is keeping in mind the difference between *determining* and *modifying* properties, where the former *articulate* and the latter *modify* the meaning of an expression. Take for instance the expression 'painted landscape', where the property 'painted' has a determining role if the expression refers to the canvas or a modifying one if it refers to the *real* landscape, the subject for a painter, as said. Similarly, regarding the expression 'object of thought', the property 'of thought' has a determining role if the expression refers to the *content* or a modifying one if it refers to the *object*, the 'world object' so to speak. In this way, Twardowski manages to disambiguate Brentano's notion of 'object of thought'. With Twardowski's handy distinction, only the content deserves to be called immanent or in-existent, that is existing within the mental act, while the object should be intended as *transcendent*, that is to say, as a mind-independent entity (Jacquette, 2015). With respect to

the mental act of presentation, Twardowski suggests reflecting the difference between content and object by using two modes of expression:

> We shall say of the content that it is thought, presented, *in* the presentation; we shall say of the object that it is presented *through* the content of the presentation (or through the presentation.) What is presented in a presentation is its content; what is presented through a presentation is its object (Twardowski, 1894/1977, p. 16)

Objects are presented *through* the content of the presentation, thus contents as such have a *mediating* function between mental acts and objects. Although contents exist, they exist only as part of the act, and even if sometimes Twardowski assimilates them to meanings, contents are conceived of as psychological or mental entities (cf. Gyemant, 2015; van der Schaar, 2016; Raspa, 2018a). Moreover, Twardowski holds that every mental act has both content and object, be it existent or not, and the former can never take the role of the latter and *vice versa* (Gyemant, 2015). As van der Schaar (2016) has stressed, the fact that, according to Twardoswki, there are not objectless presentations, has relevant consequences from an ontological point of view, which will lead him to develop a theory of objects (*Gegenstandstheorie*) anticipating what will be, as we shall see later on, Meinong's theory of objects. Being a careful reader of Bolzano but, at the same time, faithful to Brentano's intuition that every mental act has its object, Twardowski rejects Bolzano's thesis of objectless representation. According to Heffernan, Bolzano's logical objectivism posits

> abstract logical entities that determine which objects, if any, mental acts refer to, i.e., are about or are directed at. From a logical objectivist perspective, mental acts, which are located in space and time, are dependent on subjects, whereas their objective contents, which are not thus located, are independent of the subjects in whose mental acts they can be instantiated. According to Bolzano, reference in intentionality involves two relations, one between the mental act and the abstract logical concept and another between the concept and the referenced object. Thus, if a mental act is about a non-existent object, the concept, i.e., the objective "content" (*Stoff*) of the mental act, is empty or "objectless" (*gegenstandslos*) (*Wissenschaftslehre*) (Heffernan, 2015, p. 72).

As we just said, as opposed to Bolzano, Twardowski maintains that every mental act not only has content but also an object and they must be distinguished. Now, for Twardoswki when a mental act is about a nonexistent object, such as 'the round square', the incompatible properties of being round and being square can't be attributed to the content, "for the content exists, and therefore cannot have any incompatible properties. So there is an object, a round square, although it does not exist" (van der Schaar, 2016, p. 13). This is a consequence of Twardowski's metaphysical notion of object as the 'something', which states that everything "which is, is an object of a possible presentation; everything which is, is something" (1894,

p. 34). In other words, as Poli (1996) has convincingly maintained, for Twardowski the concept of object is synonymous with 'conceivable', that is every object that can *be thought* through a *presentation*, namely a *presented object*, which in turn can be considered indeed as an *intentional object.* The presented object is such apart from being existent or not, possible or impossible, since "the object is the simple 'something' that can be presented and whose modes (existence, possibility) are extraneous to its correlation with the presentation" (Poli, 1996, p. 212). Furthermore, given that Twardowski claims that everything "which is in the widest sense 'something' is called 'object,' first of all in regard to a subject, but then also regardless of this relationship"(1894, p. 37), it is reasonable to assume that objects of the mental act of presentation, that is intentional objects, are *mind-independent entities* (cf. van der Schaar, 2016). Note also that Twardowki's notion of 'object' as the 'something', if understood as the highest genus, is equivalent to the already discussed notion of *summum genus* (Poli, 1996), which would be espoused and further developed by Meinong in the direction of the *principle of independence* of being from being-so (Raspa, 2008).

With this in mind, let us move on now to Husserl's view on intentional objects, starting out with his criticism of Twardowski's theory. The Brentanian thesis embraced by Twardoswki, according to which every mental act of presentation has its object, is somewhat paradoxical to Husserl, given that if on the one hand, the father of phenomenology accepts that there is an object for every presentation, on the other he agrees with Bolzano's thesis of objectless presentation (cf. Heffernan, 2015). But what does Husserl mean by that?

According to Gyemant (2015), Husserl contends that every presentation has an *intentional object*, but this is not a type of object, rather a type of *content*. Let's explain with a simple example. When a mental act presents a nonexistent object, like Pegasus, such an act has content but fails to refer to an object. Conversely, when a mental act presents an existent object, for instance, the Statue of Liberty, the act still has content and also refers to an object. But specifically, Husserl can't accept that our mental acts can be about nonexistent objects, because for him nonexistent objects, are not objects at all (Gyemant, 2015). However, we are allowed to say that in both the abovementioned cases mental acts have *intentional objects*, which range *on the side* of the content, not of the object. In other terms, Husserl neatly separates the notion of *intentional object* from that of reference (Gyemant, 2015). As Smith and McIntyre (1982, 1989) have shown, the genesis of Husserl's notion of intentional object can be found in *Logical investigation*s (1900), but will be up by the time of *Ideas* (1913), with the distinction between the *noesis* and *noema* of an act. Very roughly, both

noesis and *noema* are contents, although of a different sort. The *noesis* is the 'real' content that is part of a particular mental act:

> An act itself is an experience, one of the temporal events that make up a person's stream of consciousness. Such an experience is surely a complex event, consisting of various phases or experience-components. What Husserl calls the real content of an act is just the sum total of these component parts of an experience, which go together in such a way as to make up the complete experience. Real content, then, consists of the temporal parts that compose, and so are literally found in, an intentional experience (Smith & McIntyre, 1989, p. 10).

Real contents are specific to a particular mental act that occurs at a certain time, thus they are different from person to person. But there is a sense in which different subjects, but also the same subject at different times, can share the same content. Such content is a *noema*, "which is not literally 'in' the act as its actual constituents are; rather, it is an abstract or 'ideal' structure that different acts can 'share'" (Smith & McIntyre, 1989, pp. 10–11). Therefore, the *noema* is an *abstract* or *ideal* entity, more precisely a *meaning* that different subjects can grasp, and as such is a *mind-independent entity*. As Smith and McIntyre (1989) have stressed, Husserl sees the *noema* as the *intentional object*, which turns out to be a *mediating* entity, since it is in virtue of such content that a mental act succeeds to have an actual object or reference, provided that there is any. Now, we can easily see how both Twardoswki and Husserl adopt a *triadic* view on intentionality, namely a theory in which three distinct elements are at stake: mental acts, contents, and objects[29]. But there is a relevant difference between the perspectives of the two philosophers: if on the one hand, Twardowski sees the intentional object as the presented object, thus on the side of reference, on the other Husserl sees the intentional object as the *noema*, thus on the side of content. However, both theories conceive of the intentional object as a *transcendent object*, that is a mind-independent entity.

It is interesting to note that, as Sacchi (2007) has remarked, Twardoswki and Husserl's theories of intentional objects are the basis of the so-called 'Traditional picture (TP)' on intentionality, which is a label that denotes a family of contemporary theories that share the thesis that only *existent objects* should be regarded as *intentional objects*. What characterizes TP is a triadic view on intentionality where contents are a kind of mediating entity by which mental acts can manage to *indirectly* refer to objects, provided that such objects exist. Haldane's (1989) reformulation of Brentano's thesis, which has already been explained

[29] The triadic perspective represents the traditional reading of Twardowski's theory. For a different interpretation that distinguishes four elements (i.e. mental acts, contents, intentional objects, and real objects), see (Gyemant, 2015).

above, might be considered a typical example of the traditional picture of intentionality, which posits that having content is a feature of mental acts that is independent of the existence of objects because, at least in some cases, there are no objects which we can refer to, but still our mental acts have content.

But actually, according to what has been said, it would be more correct to state that the TP does not lie as much in Twardowski and Husserl's conceptions of intentionality and intentional objects, but rather is much more inspired by Frege and Bolzano. As we have just said, Twardowski's theory of intentionality, as well as Husserl's theory, can be seen as built on three levels extending in mental acts, contents, and objects, where contents are mediating entities. From a linguistical standpoint, as Smith (1996) has brought out, Twardowski's distinction between contents and objects is very similar to Frege's distinction between sense (*Sinn*) and reference (*Bedeutung*). As is well know, in *On Sense and Reference* (1892) Frege holds that linguistic expressions express senses by which they denote their references. Thus, senses *mediate* the reference to an object. With respect to senses expressed by singular terms, what is denoted are particular objects. When objects exist, they are denoted by (possibly different) senses, for example, expressions like '2+2' and '2^{2}' express different ways to denote the same object, that is the number 4. Therefore, senses are 'modes of presentation' of denoted objects, *meanings* that are cognitively grasped by subjects. In the event that objects do not exist, singular terms do not have references, but still, have senses. Furthermore, senses are commonly conceived of as *abstract entities* that exist independently of the subject's thoughts. In other words, senses are not private mental entities, so that different subjects are able to grasp the same sense through which they can refer to the same object. Similarly, Twardowski's theory can be interpreted pretty much in the spirit of Frege's analysis, in the sense that *contents* and *objects* respectively play the role of *senses* and *references*, but with the difference that contents are not, as opposed to Fregean senses, mind-independent entities, in fact as we know they are *mental entities*. Furthermore, Twardsowki's metaphysical notion of object is completely different from that of Frege, which is instead in many respects similar to Bolzano's. However, even if we overlook the differences between Twardowski's and Frege's proposals about contents and objects, the two approaches do not line-up with each other, since the research perspectives coincide only in part: while Twardowski is interested in both psychological and semantic aspects, Frege is definitely oriented to the latter, according to his antipsychologistic position.

Getting back to the analysis of TP, we have seen how it adopts a triadic structure rejecting non-existent objects, calling into question the argument that, regardless of the fact that the

objects of mental acts exist, we are able to cognitively grasp something, namely a content. TP gets leverage on the 'substantial realism' on contents, that is "a position according to which contents, conceived as some sort of self-subsistent entities, belong to the inventory of what there is" (Sacchi, 2007, p. 137). Put more simply, contents are *reified*, which means they are treated as full-fledged entities, in particular, contents are typically seen as *abstract objects*, like for example Frege's and Bolzano's contents. Now, from what has been said, TP appears to be similar to Twardowski's and Husserl's theories in so far as it holds a triadic view where contents are interpreted as mediating entities. However, it differs in a conspicuous way from both Twardsowki and Husserl, in the following sense: a) TP holds that intentional objects are nothing but existent objects, while for Twardsowki intentional objects are both existent and nonexistent; b) if, on the one hand, TP sees intentional objects on the side of reference, on the other Husserl conceives of intentional objects on the side of content.

To sum up, we might say that, rather than being inspired by Twardoswki's and Husserl's theories, TP turns out to be the exact counterpart, at the level of philosophy of mind, of Frege's linguistic theories of reference (cf. Voltolini & Calabi, 2009). TP supports the view of contents as mind-independent entities (typically interpreted as abstract) thanks to which mental acts are about intentional objects (i.e. existent objects), and in cases where objects do not exist, mental acts have only contents. Within this view, the content plays a mediating role *between* the mental act and the object. That means that contents are the immediate relata of mental acts, which indirectly refer to objects. This, in turn, means that we have two kinds of relations. On the one hand, a *direct* relation between the mental act and the content, on the other, an *indirect* relation between the mental act and the object, where contents are seen as mediating entities.

The former relation is identical with what we called 'directedness (DS)', that is the fact that mental acts have contents; on the other hand, the latter is a *complex* relation composed of two different relations, that is, DS plus what we might call the 'determination (DT)' relation, namely what allows contents to identify or pick up objects, provided that such objects exist[30]. DT corresponds to what we called 'mental reference', the fact that mental states refer to objects. We might call this complex relation 'mediated intentionality (MI)'. Since TP holds a mediating theory of reference, it is impossible to conceive of such reference without the

[30] The distinction between simple and complex relations about intentionality has been taken up by Voltolini and Calabi (2009).

content, that is the mediating entity; this explains why we should see MI as a complex relation.

The distinction between DS and MI is necessary to account for the fact that, according to TP, in cases of nonexistent objects, mental acts have only contents, hence DS is involved. Anyway, when there are both contents and objects, it is MI to be involved. We can represent the whole picture of TP's triadic view as follows:

The above scheme might be also applied to account for Twardowski's and Husserl's theories, as these are triadic as well as TP, without forgetting, however, the already discussed differences among the three theoretical frameworks. Regarding Husserl, basically, the picture is identical to TP, in the sense that sometimes mental acts only involve DS, other times MI. With respect to Twardowski, the theoretical basis is slightly different. Similarly to Husserl and TP, Twardowski posits that the mental act "has a different relation to its content and to its object: it *has* a content but *refers* to an object" (Gyemant, 2015, p. 89). In any way, in contrast to both Husserl and TP, he maintains that every mental act has both content and object, thus mental acts always involve MI.

Up until now, we have seen how the Brentanian thesis has been developed by Twardowski and Husserl in the direction of a mediating theory of mental reference which has been taken up, although within a Fregean framework, by TP. Note that, differently from Brentano's early position about intentionality (where intentional objects correspond to immanent objects, thus mind-dependent objects), Twardowski's and Husserl's theories, as well as TP, interpret intentional objects as transcendent objects, namely mind-independent objects.

Finally, let's move on to the last approach to intentional objects which we are interested in, that is, Meinong's theory of object. As Jacquette (2015) has pointed out, Meinong has always claimed that objects are mind-independent entities, hence rejecting any form of idealism or psychologism. First of all, it should be emphasized (Raspa, 2006) that Meinong's theses about the notion of object have been introduced in *The Theory of Objects* (1904), although they can be found, in embryo, in earlier studies, especially in *On Objects of Higher Order*

and their Relationship to Internal Perception (1899) and *On Assumptions* (1902). Being a student of Brentano, Meinong holds that every mental act has its object and that intentionality is the mark of mental phenomena, in opposition to physical ones. From the Brentanian education on intentionality and the embracement of Twardowski's distinction between mental act, content, and object, the Meinongian assumption of nonexistent objects (Raspa, 2008), according to which "There are objects of which it is true that there are no such objects"(Chisholm, 1960, p. 83), follows. Such a statement sounds overtly paradoxical, but it can be easily interpreted in the light of the fact that Meinong posits different senses of *being*, distinguishing between objects that either *exist* or *subsist*, and objects that neither exist nor subsist, which are said to be *outside the being*. While the existence is qualified in terms of persistence in time and therefore can be predicted, for example, of physical objects, there are objects that do not have spatio-temporal characterization, like abstract objects, including numbers and relations, which are said to *subsist* rather than exist. Finally, some nonexistent objects neither exist nor subsist, including Pegasus, the round square, the golden mountain. According to Meinong, with respect to an object, we can speak of its *Sosein* (being-so), its characterization so to speak, regardless of its *Sein* (being); in other words, regardless of the fact that such object exists or subsists. More generally, for Meinong "The object as such…stands 'beyond being and non-being'" (Chisholm, 1960, p. 86). This outlines Meinong's criticism leveled against the so-called 'prejudice in favour of the real', which states that "we may speak of a Sosein only if a Sein is presupposed" (Chisholm, 1960, pp. 81–82). Meinong's conception of object includes every kind of object, be it existent, subsistent, or nonexistent. As Raspa has pointed out:

> the object is, still following Twardowski, the *summum genus*, in other words that something to which no other concept is superordinate. This is fundamental because it means that anything that can be apprehended by a mental experience or expressed by language is an object; but furthermore that 'object' for Meinong is not binding as regards the being or essence of something (Raspa, 2006, p. 49).

Now, let us take into consideration what kind of entities, within Meinong's theory of objects, should be considered intentional objects. According to Jacquette, whatever object is related to a mental act might play the role of an intentional object:

> Meinong's theory accordingly subsumes not only existent objects, but also nonexistents and nonsubsistents. Included are incomplete or fictional objects that contingently fail to exist, and impossible objects that cannot exist as a matter of metaphysical necessity. Meinong's theory is meant to accommodate this generous variety of objects, regardless of their ontological status, as the intentional objects of possible psychological experience (Jacquette, 1996, p. 8).

Conversely, according to Smith and McIntyre (1989), the Meinongian intentional object would be a specific kind of nonexistent object, that is *incomplete* object, given that such objects are supposed to be the immediate relata of mental acts. Meinong draws a distinction between objects that do not infringe the laws of excluded middle, which are called *completely determined* or *complete objects*, and those objects that are not subjected to such law, which are called *incompletely determined* or *incomplete objects* (Findlay, 1967). The triangle, by definition, has three sides and three angles, but it comes in many different forms; if someone thought about a triangle as such, it could be neither true nor false to say that it is, let's say, an equilateral triangle since it could be scalene or isosceles (cf. Raspa, 2008). More generally, an "object o is incomplete iff there is a property F such that o is neither F nor not F" (Rapaport, 1978, p. 156). As opposed to incomplete objects, all objects that exist or subsist, that is to say, have some form of being, are complete objects. Now, as Smith and McIntyre have remarked,

> due to the finite capacities of the human mind, we can never conceive any such complete object. Acts of intending complete, existent objects are, strictly speaking, directed to incomplete objects that stand proxy for them. When Smith conceives Napoleon, for example, he cannot conceive Napoleon in all his detail; rather, he conceives only an incomplete object, e.g., "the vanquished at Waterloo". Smith intends Napoleon, not in the sense that Napoleon is the object of his intention, but in the secondary, or indirect, sense that what he does intend - viz., the incomplete object "the vanquished at Waterloo" - is "embedded in" the complete object Napoleon (that is, the properties of this directly intended incomplete object are properties shared by exactly one existent complete object, namely, Napoleon (Smith & McIntyre, 1982, p. 56).

Hence, incomplete objects play a key *gnoseological* role, to the extent that we cannot fully know a complete object, but only an incomplete one (Raspa, 2008). Contemporary philosophical approaches to intentional objects that are directly inspired by Meinong hold that nonexistent objects, more precisely incomplete objects, are the immediate relata of mental acts and as such deserve to be called intentional objects (cf. Voltolini & Calabi, 2009). Along this line, the intentional object is either conceived as the object correlated with a set of properties (Castañeda, 1989; Parsons, 1980) or as the set itself (Rapaport, 1978). Another version freely inspired by Meinong leverages possible and impossible worlds semantics (Berto, 2008, 2013; Priest, 2005). While existent objects exist only in the actual world, there are possible worlds, different from the actual, in which objects as Pegasus and Boogyman exist; the same holds for an impossible object like the round square that exists only with respect to impossible worlds. Within this version, intentional objects might be not only incomplete objects but every kind of entity to which mental acts are related by means

of intentionality, therefore assuming from time to time a variety of entities as immediate relata of mental acts.

At any rate, Meinong's conception of the relationship between mental acts and objects seems to assume *contents*, rather than objects, as *immediate relata* of mental acts, thus it appears to be much more similar to the already discussed mediating theories of mental reference. Within these theories, it is possible to distinguish between three elements, that is mental act, content, and objects, and two relations that are DS and DT, which in turn can be interpreted as the complex relation MI. Now, as we have already said, following Twardowski, also Meinong distinguishes between mental act, content, and object, posits that the content varies with the object, that is for every object there is a correspondent content (Raspa, 2008). Hence, in the same way as Twardsowki, Meinong adopts a mediating theory of mental reference, in which mental acts always involve both content and object, where contents are mental or psychological entities through which objects, that are instead *transcendent entities*, are presented. Therefore, Meinong's view on mental reference can be described by resorting to the complex relation MI, in much the same way as Twardowski. If this is the case, it goes without saying that Meinongian approaches, that seem to interpret objects as the immediate relata of mental acts, overshadow the role of the content as a mediating entity with respect to Meinong's theory of objects, a role inherited by Twardowski's lesson. In any case, Meinongian approaches shed light on a perspective on intentional objects, in which there are not mediating entities, namely mental acts are *directly related* to intentional objects by means of a reference intentionality relation, which simply coincides with DT. This perspective yields a dyadic structure composed of two elements and one intentional relation, which can be represented as follows:

To sum up, so far we have said that reference intentionality can be seen alternatively as a *relational* property or as a *monadic* property, the latter being the case of the Adverbialist theory. Relational theories can be subdivided into two categories, depending on whether they hold a mediated perspective (e.g. Twardowski, Husserl, TP, Meinong) or a direct one (e.g.

Meinongian approaches) on the mental reference. A further distinction can be made in accordance with intentional objects' dependence or independence as regards mental acts, that is: on the one hand, we have theories in which an intentional object is an immanent object (mind-dependent object), like for example Brentano's early position. On the other, there are theories whereby the intentional object is interpreted as a transcendent object (mind-independent object), including Twardowski, Husserl, TP, Meinong, and Meinongian approaches.

It should be noted, moreover, that there are several variations of theories that we have discussed until now, yet providing a full account of all approaches to intentional objects falls outside the scope of this dissertation. Our more humble target in this section was to highlight some basic assumptions that every theory of intentional objects has to take up, in one way or another, to deal with the metaphysical problem of intentional objects.

In the next section, we are going to introduce our proposal on the topic, which can be applied to all those theories that assume a relational conception of intentionality and posit intentional objects as transcendent objects. This entails that our theory has the limitation of not being able to account for those perspectives that see intentional objects as immanent objects, as well as it is unable to fully explain away intentional objects within the mentioned Adverbialist framework. In any way, our proposal helps clarify a crucial point concerning the metaphysical problem of intentional objects. As we have shown, from time to time, depending on the particular theoretical framework, very different kinds of entities are selected to be intentional objects. So in a sense, it seems that many entities can play the same role, that is, being an intentional object. In the next section, we will attempt to single out the meaning of such a role, providing a definition of intentional object that can be suitable for different kinds of entities. What we are saying is that our proposal has the obvious advantage of accounting for theories that have mutually exclusive ontological assumptions, being applicable to philosophical outlooks that are ontologically committed only to existent objects as well as to those that contemplate nonexistent and impossible objects. There are two more things that should be clarified. First of all, we will not get into details about the peculiarity of intentionality as a mental phenomenon, that is we will not attempt to answer the question 'What makes a mental state/event an intentional mental state/event?'. Usually, there are two possible solutions available to such a question: a) the peculiarity of intentionality can be explained holding that it is a special kind of relation, different from ordinary relations such as 'being taller than'; b) intentionality is an ordinary relation, rather exactly intentional objects, being a special kind of entities (e.g. nonexistent object or abstract objects) are what

explains the peculiarity of intentionality itself. We remain neutral with regard to such a matter, but it should be noted that our theory is compatible with both solutions. Finally, according to theories on intentionality that we have examined, the reference intentionality relation (RI) can be interpreted in three different ways. With regard to the theory of direct reference, RI is equivalent to DT. Speaking about theories of mediated mental reference instead, we can make a further distinction. When both contents and objects are always involved RI can be seen as the complex relation MI, and this is the case of Twardowski and Meinong. However, from Husserl's and TP's standpoints, we have said that sometimes mental acts involve DS, other times MI. Now, within this framework, not only MI as a whole but also DS in itself can be considered a kind of reference intentionality relation. In fact, DS is intended to explain what it means for a mental act to be about an object when such an object does not exist. And as we know, the answer is that the mental act is related to a content, yet such content is *reified*, is treated as if it was a full-fledged object, thus DS turns out to be a binary relation between a mental act and an existent object, typically an abstract object (cf. Voltolini & Calabi, 2009). To sum up, RI can be interpreted as DT or DS or MI.

2.4 Intentional objects as roles

Up until now, in taking into account theories of intentional objects, we have often mentioned that an entity rather than another can *play the role* of the intentional object. We believe that this is not only a way of speaking, rather it is actually a clue that reveals something deeper about the metaphysics of intentional objects. We can find traces of this in the philosophical literature. As Smith and McIntyre have pointed out, there is a sense expressed by the locution 'intentional object' that calls on the role that an entity plays in intentionality, according to which "the intentional object of an act is simply the object toward which the act is directed - that is, the intended object, there being no suggestion that such an object must be of some peculiar ontological type or status" (1982, p. 46). Recently, the thesis that intentional objects are not specific kinds of objects has been supported by Crane (2001a, 2001b), who believes that such objects are *schematic objects*[31], which are defined in contrast to substantial objects:

[31] It is worth noting that Crane's notion of 'intentional object' as a schematic object is based on a phenomenological perspective. Such a perspective, however, doesn't refer to the phenomenological movement inaugurated by Husserl. Instead, the word 'phenomenon' should be understood here in the general sense, that is in terms of 'appearance' (Crane, 2001a, p.8). In this respect, when it comes to explaining what are schematics objects, locutions such as 'object of attention', 'object of experience', 'intentional object' are used interchangeably (Crane, 2001a, p. 16). Since it is possible to think about or turn our attention to (i.e. having the experience of) very different kinds of objects, an intentional object, *qua* schematic object, doesn't represent a particular kind of entity among others. Accordingly, Crane's view does not involve any sort of ontological

> This substantial conception of an object—the conception of a kind of object having a certain nature—can be contrasted with another kind of conception, which we could call the schematic idea of an object. This is the kind of idea we find expressed in phrases like 'object of attention'. An object of attention is something to which someone is or can be attending. But clearly there is nothing which all objects of attention need have in common: objects of attention have no 'nature'(Crane, 2001a, p. 17)

Along this line, different entities count as an intentional object, to the extent that such entities enter into a reference intentionality relation with a mental state or event. In other terms, '*being an intentional object'* can be seen as a role played by several entities. Although this sense of intentional object is present in the relevant literature, as far as we know, there are no attempts to take the notion of *role* at face value from a metaphysical point of view [32]. What we are saying is that, in order to figure out what it is that an entity whatever *plays a role* within the intentional relation, first of all, we have to understand what is a *role*. Therefore, the aim of this section is to find out a characterization of the notion of 'role' that could be suited for defining intentional objects.

Before introducing theoretical key aspects that will help us to get a grip on the notion of role, we want to make a few remarks. It should be noted that alongside the abovementioned sense of 'intentional object', there are at least two other meanings that deserve to be spelled out (cf. Smith & McIntyre, 1982), namely: a) the intentional object conceived of as a peculiar kind of entity (e.g. abstract object, nonexistent object); b) the intentional object interpreted as the entity that might explain the peculiarity of intentionality as a mental phenomenon. In any way, speaking of relational theories of intentionality, the most fundamental sense in which an intentional object should be understood is that which calls into question the role of an object in intentionality, that is to say, the intentional object is the object which the mental state or event is about. This sense represents a necessary condition for a) and b). To see why this is so, consider that every relational theory of intentionality sees, at least, intentional

commitment to intentional objects. On this point, we are in agreement with Crane, given that also our theory of intentional objects as roles does not entail an ontological commitment (yet, as we shall see, the notion of 'role' that we espouse does not in principle exclude the possibility to be adapted to other theories which instead are ontologically committed). Moreover, differently from Crane, our metaphysical analysis doesn't appeal to phenomenological arguments (or, more generally, to the concept of 'experience') in claiming that every kind of object can be an intentional object.

[32] With the exception perhaps of Sacchi and Voltolini (2012), who put forward the idea that a mental state or event x about an object y, is nothing but such y playing a certain *motivational role* for a subject z that entertains x. Note, however, that the motivational role played by the intentional object accounts for the individuation conditions of a mental event or state, rather than detailing the intuition that an intentional object is just the object toward which a mental state or event is directed. Furthermore, Sacchi and Voltolini do not seek to provide a genuine metaphysical characherization of the notion of role itself, something that we will try to do. Finally, intentional objects that play a motivational role are literally part of the mental state or event, that is to say the mental state or event is costitued by such objects. Conversely, as we shall see, our proposal rules out the possibility that the entity that plays the role of intentional object entertains a part-of relation with a mental state or event.

objects as a *relatum* of reference intentionality relation (RI). Moreover, since a high level of generality is required to keep the framework on intentional objects as roles applicable to theories that see mental states, rather than mental events, as the left-hand relatum of intentionality, we will use the term 'thought' as referring to both mental states and mental events.

This being said, let's focus on the notion of role, which has been analyzed in many fields, ranging from computer science (e.g. knowledge representation, knowledge engineering, object-oriented and conceptual modeling, multi-agent systems) to linguistics, philosophy, and cognitive science [33]. For starters, note that it is very difficult to provide a common definition of role:

> little agreement seems possible among the proposals in the different fields […] The likely reasons of these divergences are that many papers on the notion of role fail to have an interdisciplinary character, that much work proposes new definitions of roles to deal with particular practical problems, and that role seems an intuitive notion which can be grasped in its prototypical characters, but it is instead a deceptive one when details must be clarified (Boella et al., 2007, pp. 81–82).

Besides, it should be emphasized that a few philosophical studies have been dedicated to singling out what it means to play a role. Among them, immediately Searle's (1995) work on social ontology comes to mind, which is based on a complex interlace of notions like collective intentionality, language, and constitutive rules, that contribute to the construction of social reality through status functions expressed by the famous formula 'X counts as Y in context C', where X stands for an entity upon which a status Y has been imposed (i.e. a social role we might say) in a certain context C, for instance, a piece of paper such and such counts as 20 $ in the world economy. Moreover, while remaining within social ontology, Raimo Tuomela (1995) has suggested his theory of social roles that is underpinned by considerations about social tasks and rights. More recently, outside the social ontology domain, Francesco Orillia (2011) has brought forward the notion of Onto-thematic Roles, which are the ontological counterparts of thematic roles in the language (e.g. patient, agent, location, etc.) that express semantic relationships between verbs and their arguments. Take for example the sentence 'Marco kicks the ball', where the verb 'to kick' assigns to 'Marco' and 'ball' the thematic roles 'agent' and 'theme' respectively. Onto-thematic Roles are adopted in accounting for the problem of relational order that states of affairs entail regarding

[33] For a review on how the concept of role has been drawn up in different fields see Masolo et al. (2004).

non-symmetric relations (e.g. expressing states of affairs by means of locutions of gerundial form, we have 'Romeo's loving Juliet' and 'Juliet's loving Romeo').

But, actually, most ontological analyses of the notion of role fall outside philosophical ontologies properly so-called. Many studies on roles can be found in ontology as conceived of in the vast landscape of computer and information science. In this field, roles can be considered an ontological primitive, alongside objects, relationships, and classes, given their pervasive relevance to deal with knowledge representation issues (Boella et al., 2007). Within this ontological perspective, the classical approach for analyzing the notion of role based on the works of Sowa (2000; 1989) and Guarino (1992) shows a general attitude to the definition of such concept, which is in line with the metaphysical sensitivity that carves out reality from an abstract and general standpoint. In this respect, this classical approach to roles appears to be particularly suitable for clarifying our view of intentional objects. Hence, let us introduce the basic principles on roles, endorsing Sowa and Guarino's arguments.

First of all, Sowa claims that a role is a *monadic property* which can be predicated of different entities; in technical terms, different entities can play the same role. For example, the role 'customer' can be played by a person as well as by a company. Furthermore, an entity plays a role only with respect to a 'pattern of relationships'. For instance, the role 'university student' holds only within a binary relation of 'enrollment' to a university. Guarino adds constraints to Sowa's theory affirming that roles must be *founded* and *anti-rigid*. The notion of foundation or, better, generic foundation, has been formulated by Husserl. Speaking about Husserl's concept of foundation, Simons (1982) and Correia (2004) claim that this is a binary relation between entities such as 'species' or 'kind'[34]. However, in order to prevent confusion with how such terms are interpreted in the ontological literature, here we rather preferred to assume that foundation is a relation that holds between entities denoted by the generic term 'property'[35]. Hence, the foundation relation expresses the idea

[34] The notion of 'foundation' is used by Husserl to characterise the concept of 'pregnant whole', that is a whole in which each part is "foundationally connected, directly or indirectly, with every other, and no part of the whole so formed is founded on anything else outside the whole" (Simons, 1982, p. 122). Husserl interpreted the foundation relation as a necessary association between kinds. The father of phenomenology conceptualized a pregnant whole as a more comprehensive union between kinds, differently from a mereological aggregate. Simons has stressed (Simons, 1982, pp. 122–125) that if we formulated the connection between instances of different kinds in terms of parthood or proper parthood, we would not be able to capture Husserl's original intuition about pregnant whole and foundation.

[35] The introduction of this terminological adaptation is legitimate to the extent that terms like 'species', 'kinds' and 'properties' all refer to entities that exemplify or instantiate particulars. To remain faithful to Husserl's intuition of generic foundation, basically we have to avoid that such relation is thought of as a relation between particulars. In this case, we would have a relation called *objectual foundation*, which is different from the generic foundation because the former holds between particulars whereas the latter between entities that exemplify or instantiate particulars (cf. Correia, 2004; Simons, 1982).

that a property α cannot exist as such except in a more comprehensive unity with a property β. For example, 'being a lake' is such as founded on 'being a dry land', 'being a wife' is such as founded on 'being a husband', and *vice versa*. The former is a one-sided foundation relation (not symmetric), the latter is a two-sided or mutual foundation (symmetric) (Simons, 1982). On the basis of Simons (1982, p. 125), we might define the generic foundation as follows:

Property α is founded on property β if and only if any instance x of α is necessarily associated with an instance y of β which is not related to x by a part-of relation.

Thus roles are founded properties, for example, 'university student' is founded on 'university', 'supplier' is founded on 'customer', and so on. Besides, roles have a *dynamic temporal* relation with respect to entities by which they are played, in the sense that: a) the same entity could play different roles simultaneously or at different times; b) the same entity could play the same role several times; c) different entities could play the same role at different times. Furthermore, it is worth noting that if an entity y instantiates the property β = person and the property α = student, then y can cease to be a student (or whatever role you like) without changing its identity conditions, but can't cease to be a person, otherwise y would be a different entity. In other words, 'being a person' is a *rigid* property, that is in every possible world this property applies to all its instances necessarily. Instead, 'being a student' is an *anti-rigid* property, namely, it doesn't apply necessarily to all its instances[36]. Hence roles are anti-rigid properties. More formally, we might represent *rigidity* and *anty-rigidity* with regard to a property α as follows:

- Property α is rigid:
  $\forall x\ (\Diamond\alpha(x) \rightarrow \Box\alpha(x))$

- Property α is anti-rigid:
  $\forall x\ (\Diamond\alpha(x) \rightarrow \neg\ \Box\alpha(x))$

This being said, let's apply the approach to roles that we have just sketched out to the analysis of intentional objects. What is it to be an intentional object?

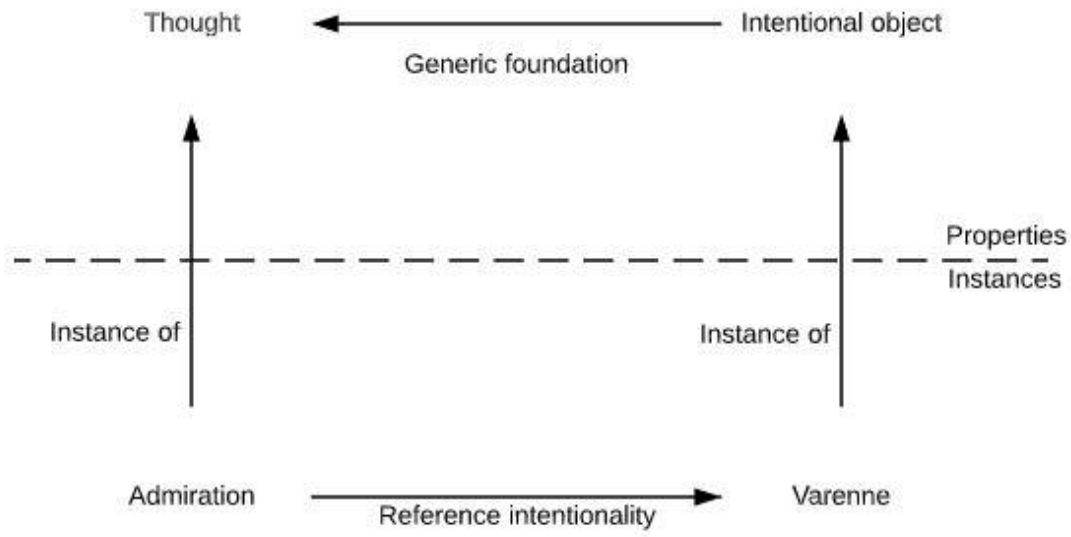
[36] The distinction between rigid and anti-rigid properties can be compared with the one between essential and non-essential properties. See (Guarino & Welty, 2004).

With respect to a certain entity, we suggest that being an intentional object is nothing but playing a role within a *reference intentionality* relation. Let us use the term 'aboutness' as equivalent to 'reference intentionality', then aboutness is a relation holding between an agent's thought 'X' and an entity 'Y'. The point is that the role of intentional object 'Z' is played by 'Y' to the extent that 'X' is about 'Y'. For instance, suppose that Paul admires Varenne. Given that Varenne is related to Paul's thought by means of aboutness, or, in other words, Paul's thought (of admiration) is about Varenne, Varenne as such plays the role of intentional object. It is worth noting that we are not embracing here an ontological multiplicative approach, that is, we are not stating that the intentional object Varenne is a different entity from Varenne. All we are saying is that, only insofar Varenne is the 'target' of Paul's thought, it instantiates a certain quality or property, which is the property of being an intentional object. We believe that two interesting consequences can be deduced from these observations. First of all, let the property Φ stand for the property 'being an intentional object' and Ψ for the property 'being a thought'. We can affirm that any instance x of Φ is necessarily associated with an instance y of Ψ which is not related to x by a part-of relation (where the association relationship between instances corresponds to aboutness). So Φ is founded on Ψ. In addition, the property Φ is anti-rigid. In fact, it is only to the extent to which an entity is involved in an aboutness relation with a particular thought that this entity instantiates the property Φ.

Since Φ is a founded and anti-rigid property, Φ is a role. In our example, Varenne (an individual) plays the role of intentional object insofar as (and at the time in which) Varenne is what Paul's admiration is about. To sum up, Φ is a monadic property that can be predicated of different entities and this is a welcome result if one wants to maintain the idea that different kinds of objects can be intentional objects.

Note that, in general, the adopted approach to roles aims to describe nothing but the way in which an entity participates in the context of a relation, in the present case the way in which an entity participates in the role of intentional object within the context of reference intentionality or aboutness. As stated before, such a perspective can be applied to those theories that endorse two assumptions, that is a relational view on intentionality and a mind-independent conception of intentional objects. For as we have defined roles, holding these assumptions is necessary since entities that instantiate the property of 'being intentional object' must be in a reference intentionality relation with other entities that instantiate the property of 'being a thought', with the additional constrain that the latter entities cannot be

part-of the former entities. Finally, we can represent our general picture of intentional objects as roles within the context of reference intentionality in the following way:



It is time to make some clarifications on the approach to intentional objects that we are developing, outlining the main points related to how reference intentionality (RI) and its *relata* behave within mediated and direct theories of mental reference in the light of the theory of roles. First of all, note that the abovementioned schema shows that generic foundation is a relation that holds between two properties, that is 'being a thought' and 'being an intentional object', and that the latter property is founded on the former. Moreover, it shows that the association relationship between instances corresponds to RI. Note that within the schema is represented the previous example in which Paul admires Varenne, but for the sake of simplicity, we left the intentional agent Paul outside the schema, by concentrating only on Paul's thought of admiration and the related entity that plays the role of intentional object, that is Varenne. So the schema shows that 'admiration' is an instance of the property 'being a thought'. As we said earlier, a thought can be either a mental state or a mental event, thus the instance 'admiration' might be interpreted both as a mental state or a mental event. The thought of admiration is about Varenne, namely a particular[37] existent entity that instances the property 'being an intentional object'. But more generally, instances of

[37] Le us remind that, as we have stressed in section 2.2, intentional objects can be particulars, as well as properties and states of affairs or events seen as complex entities, namely particulars that instatiate properties. This also applies to our schema, that is instances of the property 'intentional object' can include particulars, properties, and complex entities.

'intentional object' might be existent or nonexistent, depending on the ontological commitment. Furthermore, we should pay attention to the fact that RI can be interpreted as directedness (DS) or determination (DT) or mediated intentionality (MI). This being said, we can easily see how our framework is applicable to theories of intentional objects that have been discussed above. Starting with Meinongian approaches, which adopt a theory of direct mental reference, we can say that entities that play the role of intentional object are incomplete objects or alternatively every kind of entity to which thoughts are about, while the RI coincides with the simple relation DT. Turning to theories of mediated mental reference, we have to draw a distinction between Twardowski's and Meinong's views on the one hand, and TP's and Husserl's perspectives on the other. We have said that Twardowski's and Meinong's theories endorse a mediated view, according to which thoughts have always both contents and objects, thus RI can be seen as MI. Note that for Twardowski represented objects play the role of intentional object, while, depending on different scholars' interpretations, for Meinong such a role can be played by incomplete objects or whatever object which the thought is about [38]. Finally, TP's and Husserl's theories involve both DS and MI to account for the fact that in cases of nonexistent objects, mental acts have only contents, thus only existent objects can play the role of intentional object. In addition, either TP or Husserl espouse a substantial realism on contents, that is contents are seen as full-fledged entities independent from the mind, more specifically contents are interpreted as abstract objects. This is very interesting because it allows us to state that, within TP and Husserl's theories, *contents are roles* just like intentional objects. Briefly, we note that: a) any instance of the property 'being a content' is necessarily associated with an instance of the property 'being a thought' without involving a part-of relation between instances and through an association relationship that corresponds to DS. Thus the former property is founded on the latter; b) we see abstract objects as entities that play the role of content, only as long as an abstract object is involved in DS with a particular thought the abstract object instantiates the property of being a content. Hence, 'being a content' is an anti-rigid property. Given that contents are *founded* and *anti-rigid*, we are allowed to assume that contents are roles. As a last remark, according to TP intentional objects range on the side of the reference, while for Husserl such objects range on the side of the content. This means

[38] It is possible to trace different interpretations of the ontological status of Meinong's intentional objects by referring to two relevant essays written by the Austrian philosopher, that is *Über Möglichkeit und Wahrscheinlichkeit* (1915), dealing with incomplete objects, and *Über Gegenstände höherer Ordnung und deren Verhältnis zur inneren Wahrnehmung* (1899), which deals in depth with the problem of mental representations and their contents.

that the application of our approach to Husserl's theory draws out that the property 'being a content' and the property 'being an intentional object' are the same property or role. We would like to make a final consideration to better clarify the reason why our view on intentional objects as roles can be made consistent with the theories discussed so far. At first glance, our proposal could appear in stark contrast to the approaches on intentional objects that we have reviewed. This is because while all such theories entail a specific ontological commitment to intentional objects (e.g. according to TP intentional objects are only existent objects, for Meinong instead intentional objects can be both existent and nonexistent), we argued that as long as something is the object of thought, such entity (belonging to whatever kind) can be considered an intentional object. In other words, our theory of intentional objects as roles rules out any ontological commitment to such objects. In still other words, insofar an entity x is the 'target' of someone's thought, x plays the role of intentional object, regardless of the ontological status of x. Yet, let us point out that the notion of 'role' that we have espoused does not in principle exclude the possibility to be ontologically committed. Generally speaking, a role may imply some restrictions with respect to the entities that are allowed to play such a role. Take for example the role of 'physician'. People who want to become a physician must, at least, obtain a medical degree. This means that not everyone can 'play' the role of 'physician' unless they meet certain requirements. Such requirements represent constraints on a role that determine what entities are allowed to play it. The same may hold for the role of 'intentional object'. As a first approximation, we have supported throughout this chapter a position on intentional objects seen as roles general enough to be appliable to all those theories that hold a relational view on intentionality and a mind-independent conception of intentional objects. In doing so, our aim was to describe nothing but the way in which an entity participates in the role of intentional object within the context of reference intentionality. But nothing prevents us to further characterize the role of intentional object adapting our view to other theories by placing a constrain on the entities that are allowed to play such a role, according to a specific ontological commitment. Let us take the case of TP, which is ontologically committed only to existent entities. In order to apply our perspective on intentional objects to TP, it will be sufficient to state that an entity x can play the role of intentional object within TP's framework if and only if x is an existent entity. And the same goes for the other theories taken into considerations in this chapter. That is to say, in order to adapt the idea of intentional objects as roles to a given theory, all we have to do is constraining the entities that play such a role according to the ontological commitment embraced by such a theory. Note that adding ontological constraints to the

entities that can play the role of intentional object, does not contradict the main assumption of our theory, that is: the notion of intentional object can be characterized resorting to the concept of role, which is defined as a founded and anti-rigid property instantiated by the entity that participates in the context of reference intentionality.

2.5 Needs as thoughts

In the first chapter, we have reviewed the most important works of contemporary need-theorists, outlining key concepts related to the ontological debate about needs. We have introduced two main ontological perspectives about needs, that is absolutism and instrumentalism. As we know, the supporters of instrumentalism believe that all needs are instrumental, that is, they are necessarily ontologically dependent on goals. On the contrary, philosophers who sustain absolutism reject the instrumentalist's assumption, claiming that, although it is true that some needs are instrumental, others are absolute, namely, they can exist independently of goals. Then we have focused on the notion of goal, introducing the distinction between *pseudo-goals* on the one hand and *goals proper* on the other, where the former are merely effects or outcomes that have been selected by evolution to maintain a certain behavior that turns out to be efficient in terms of species survival, the latter are mental representations that teleologically drive our behavior. Thus, we have suggested distinguishing between absolute and instrumental needs according to the two notions of goals introduced, namely needs that are related to pseudo-goals on the one hand, which correspond to *absolute needs*, and needs that are ontologically dependent on goals proper on the other, which correspond to *instrumental needs*. Moreover, we have underpinned that biological needs are the only kind of absolute needs, in other terms, 'absolute need' is synonymous with 'biological need', and such needs find their expression in the formula 'A needs X'. We have also stressed that absolute or biological needs are universal, in the sense that they concern all living creatures (besides, a living being could not have existed without having them), while instrumental needs pertain only to cognitive agents equipped with mental representations and, since these are the most helpful for designing PA's services, we will focus only on the latter kind of needs. In addition, we have said that, within instrumentalist philosophical positions, Doyal and Gough (1991), as well as Castelfranchi (1998), explicitly conceive of needs themselves as instrumental *goals*, that is, we must obtain what we need before and for obtaining what we aim at, namely, the end goal. Note that both instrumental and end goals are *goals proper*, that is mental representations. So needs *qua*

instrumental goals are ontologically dependent on end goals and are expressed by the formula 'A needs X for Y', even though need's claims sometimes can be expressed elliptically, that is without explicitly declaring the related end goal (e.g. I need $ 200), therefore taking the apparent form of absolut needs, that is 'A needs X'. Finally, we have further distinguished between two kinds of instrumental goals: those which represent only a sufficient condition to the end goal's achievement, and those which represent both a necessary and sufficient condition. In any way, first of all, we have embraced the view that instrumental needs are mental attitudes, that is *thoughts* about something.

Now, after having talked at length about intentionality and intentional objects, we conclude this chapter showing how the verb 'need' can be seen, at least in its *instrumental* meaning, as an intentional verb (i.e. verbs used to talk about intentional mental states or events) on a par with desires, intentions, beliefs, hopes, etc. To determine whether instrumental needs can be seen as intentional mental states or events, we might compare them to other attitudes like beliefs and desires, relating such attitudes to the three properties of intentionality introduced in section 2.1. Let us remind ourselves that these criteria are: a) the independence of thoughts from the subsistence of states of affairs: thoughts can have propositional content independently of the subsistence of the related states of affairs. For example, Maria might believe that John is a faithful husband, but that doesn't mean that he actually is; b) the possibility for thoughts to be about nonexistent objects, for instance, John's fear about Boogeyman; c) the aspectual shape, that is the object which the thought is about is always presented in a certain way, that is from a certain point of view, for example, Lois can think about the very same object once as 'Clark Kent' and another as 'Superman', and given that Lois does not know the double identity of her beloved, she can fall in love with Superman without falling in love with Clark Kent. As we know, these three properties attempt to grasp the salient features of the concept of intentionality as a property of thoughts, even if they are derived from linguistical approaches that shed light on the close relationship between intensionality (with a 's') and intentionality (with a 't'). For example, according to Crane (2001a, p. 21), the failure of the existential generalization could be interpreted as the expression of the point b), while the failure of the principle of substitutivity of identicals in terms of the point c). Finally, as we remember, b) and c) qualifies reference intentionality (RI), the property of thoughts to be about an object, while a) characterizes content intentionality (CI), namely the property of thoughts to have propositional content. Now, let's make some simple examples of needs and intentionality.

With respect to a), we know that the propositional content identifies the conditions of satisfaction related to the thought which has such content. More generally, following Searle, we might say that my "belief will be satisfied if and only if things are as I believe them to be, my desires will be satisfied if and only if they are fulfilled, my intentions will be satisfied if and only if they are carried out" (1979, p. 79). Along this line, we might say that needs, as mental states or events, can be satisfied if, and only if, there is a subsistent state of affairs that meets the condition of satisfaction identified by the propositional content. In any way, such content is independent of the subsistence of the state of affairs. For example, imagine that John is about to be tried in a private military court and that he knows that Paul's testimony could prove his innocence in court. Then we might suppose that John needs Paul to testify in the trial, yet it doesn't mean that Paul will testify because, let's say, he is involved in a secret plot and he is prevented from taking part in the trial. However, the propositional content of Paul's need is independent of the subsistence of the state of affairs that satisfies such a need. Regarding b), it will be sufficient to show that we can have mental states or events of need that are about a nonexistent object. Let us then suppose that Carla suffers from a degenerative disease and that she states that she needs a divine miracle to be healed. But if we assume that divine miracles do not exist, then we might say that Carla's need is a thought about a nonexistent object. Finally, with regard to c), we have to prove that needs imply the aspectual shape. Now, take the abovementioned example about Lois and Superman. As we said, Lois can think about the very same object once as 'Clark Kent' and another as 'Superman'. Since Lois is not aware of the double identity of her beloved, we might assume that, for example, Lois thinks that she needs Superman, rather than Clark Kent, to be rescued from dangerous situations.

With this in mind, we suggest that 'need', like 'believe', 'desire', 'intend', is an intentional verb, namely a verb used to talk about intentional mental states or events. At any rate, some scholars would be ready to deny that the verb 'need' is an intentional verb. For instance, in chapter one we have seen how Wiggins states that:

> If I want to have x and x = y, then I do not want necessarily to have y. If I want to eat that oyster, and that oyster is the oyster that will consign me to oblivion, it doesn't follow that I want to eat the oyster that will consign me to oblivion. But with needs it is different. I can only need to have x if anything identical with x is something that I need. Unlike "desire" or "want" then, "need" is not evidently an intentional verb (Wiggins, 1987, p. 6).

In the above passage, Wiggins compares verbs such as ‘want’ and ‘desire’ to the verb ‘need’, suggesting that, unlike the former, ‘need’ is not an intentional verb. But on what grounds does Wiggins say this?

It seems that Wiggins appeals to the principle of substitutivity of identicals that fails for verbs like ‘want’ or ‘desire’ but not for the verb ‘need’. And this could be true of the verb ‘need’ when it expresses an absolute or biological sense. Take the need for water, a thirsty person

> who believes that water quenches thirst and that H_2O is a kind of rat poison may want some water but not some H_2O […] However, ‘need’ contrasts with ‘want’ as regards substitution: our dehydrated subject who does not want H_2O because he believes it to be a kind of rat poison, nevertheless needs H_2O (Forbes, 2020).

However, we are not assuming here that the absolute or biological sense expressed by the verb ‘need’ is an intentional verb. As we have said, these kinds of needs refer to mere biological functions. Instead, what we are suggesting is that the verb ‘need’, taken under its instrumental meaning, is an intentional verb. In this case, it is reasonable to assume that the principle of substitutivity of identicals does not hold. To continue the previous example about Lois and Superman, given that Lois does not know that Superman and Clark Kent are the same person, if we substitute ‘Superman’ with ‘Clark Kent’ in the same sentence we obtain that ‘Lois needs Superman to be rescued from dangerous situations’ seems to be true, while ‘Lois needs Clark Kent to be rescued from dangerous situations’ seems to be false (the reason why it is so is that instrumental needs appear to be more similar to desires than to absolute needs, in the sense that we have a desire or an instrumental need according to our beliefs while, conversely, absolute needs do not depend on our beliefs, they depend on our biological constitution, so whether or not we have beliefs about H_20, we still need it in absolute terms). But even supposing that in the case of instrumental needs the principle of substitutivity of identicals is not infringed, this would not necessarily mean that the verb ‘need’, in its instrumental meaning, is not an intentional verb. As we remember, in section 2.1 we have mentioned that Roderick Chisholm has formulated a linguistic approach to intentionality (with a ‘t’) resorting to intensional (with a ‘s’) principles. Now, we have seen how the linguistic approach to intentionality has been criticized since, contrary to what was expected, it provides neither necessary nor sufficient conditions for intentionality (at most, it proves sufficient conditions to characterize intensionality). Nonetheless, given the close relationship between intentionality and intensionality, we have remarked that Chisholm’s work can be read as a doorway to the individuation of the salient features of the concept of

intentionality (cf. Voltolini, 2005). For example, as we said, with respect to sentences in which intentional verbs appear, one may argue that the failure of the principle of substitutivity of identicals is in part due to the aspectual shape exhibited by intentional thoughts. Let's take the case of belief sentences. As Crane has stressed:

> it is natural to suppose that the principle of substitutivity of co-referring terms breaks down here because whether a belief sentence is true depends not just on the object represented by the believer, but on the way that the object is represented […] So the intensionality seems to be a result of the nature of the representation involved in a belief. Perhaps, then, the intensionality of belief *sentences* is a consequence of the intentionality of the beliefs themselves (Crane, 2016, p. 25).

At any rate, Crane does not exclude that there might be intentional sentences for which the principle of substitutivity of identicals holds. In fact, the principle seems to apply to sentences of the form 'x see y', in which the verb 'see' is commonly thought to be an intentional verb (e.g. if the terms 'George Orwell' and 'Eric Arthur Blair' are co-referring terms, then if Luisa sees Orwell, then she also sees Blair (see Crane, 2016, p. 26)). Now, just like the verb 'see', the verb 'need' in its instrumental meaning might not imply, with respect to a certain sentence in which it appears, the failure of the principle of substitutivity of identicals and, at the same time, be considered an intentional verb. So, it is possible to assume that the principle of substitutivity of identicals is not a necessary condition that must hold in order to get intentional sentences. In conclusion, appealing to the principle of substitutivity of identicals, as Wiggins does, is not sufficient to prove, in general, that a verb is not an intentional verb.

Besides Wiggins, also Moltmann posits that the verb 'need' is not an intentional verb, where the latter kind of verb "is a transitive verb describing a mental act or speech act directed toward something possibly nonexistent" (2015, p. 143). Note that the sense in which the verb 'need' is understood by Moltmann, seems to be the instrumental one, given that she provides examples like 'John needs a horse', 'John needs at least two assistants', where instrumental needs are expressed elliptically. According to Moltmann (2008, 2015) verbs like need, buy, sell, recognize, should be classified as intensional (with an 's') rather than intentional (with a 't'). The former are verbs that reflect the linguistic property of intensionality, which is defined resorting to three criteria: the failure of existential generalization, the failure of substitutivity of coreferential terms, and the nonspecificity. We are already familiar with the first two, with respect to the latter, its meaning can be explained by resorting to many linguistic tests, like for example that of 'special' quantifiers. As Moltmann has outlined (2008), intensional noun phrases (NP) complements are replaced by quantifiers such as

‘something’, rather than quantifiers like ‘someone’ or ‘some entity’. For instance, the NP ‘an assistant’ of the intensional verb ‘look for’ in the sentence ‘Mary is looking for an assistant’ can be replaced by ‘for something’ thus obtaining the sentence ‘Mary is looking for something’. Moreover, intensional verbs would involve a different semantics with respect to intentional ones, examples of which are, according to Moltmann (2015), verbs like ‘think of ’, ‘describe’, and ‘imagine’, besides there are some verbs that can be interpreted as intentional and intensional at the same time, for example, the verb ‘want’. In addition to defining intentional verbs in the above manner, Moltmann (2015) provides a theory of intentional objects conceived as entities strictly dependent on mental acts.

However, a possible criticism that can be formulated in opposition to a core aspect of Moltmann’s view is the following: when she defines intentional verbs as those transitive verbs that describe mental acts or speech acts directed toward something possibly nonexistent, it seems that the intentionality of mental acts, described by intentional verbs, is reduced to the fact that such acts can be about nonexistent objects. Yet this conception of ‘intentional verb’ seems to be too week to capture many features of intentional thoughts. In fact, as we know, the possibility for thoughts to be about nonexistent objects can be considered just one of the three abovementioned properties that qualify the property of intentionality, and consequently of thoughts that instantiate it. Thus, an intentional verb, to be defined as such, should describe more than the possibility for a thought to be about nonexistent objects. As Ciecierski (2016) has stressed, the notion of intentional verb is far from being clear and homogenous. Many tests have been provided by different accounts of intentionality to determine how to distinguish an intentional mental state or event from a non-intentional one, and whether for a given intentional verb there is a correspondent intentional state or event. In this respect, the verbs “‘know’ and ‘believe’, for instance, are clearly non-synonymous, however, it is very likely that they indicate a single kind of intentional state: *the belief*” (Ciecierski, 2016, p. 37). But at the end of the day, all accounts turn out to embrace the view according to which “intentional verbs are the ones that are used to talk about intentional mental states” (Ciecierski, 2016, p. 54). So it goes without saying that, in order to capture the meaning of the term ‘intentional verb’, much depends on what we mean by intentionality as a mental phenomenon. According to our analysis of intentionality, and being aware of the abovementioned limitations, we suggest defining intentional verbs as those verbs that describe mental states or events that instantiate one or more of the properties of intentionality set out in points a), b) and c). Although it is doubtful that these properties represent necessary and sufficient conditions for the definition of

intentionality, since it is possible to find out other features of intentionality or it might turn out that such features are sheared with other properties different from intentionality (cf. Voltolini & Calabi, 2009), nonetheless such properties appear to be altogether the most highlighted characteristics of intentionality within the historical debate from its beginnings to the present day. Now, with respect to the status of instrumental needs, in chapter one we have shown how these kinds of needs have been analyzed within philosophy and cognitive science as mental representations that guide our actions in terms of means-end reasoning. Furthermore, in this section, we have pointed out that it is possible to argue that instrumental needs display the main features of intentionality as listed in points a), b) and c). Thus, in line with what has just been said, we state that the verb 'need', taken under its instrumental meaning, is an intentional verb and the entities described by such verb are intentional mental states or events.

Finally, let us clarify a relevant point that we have previously left in the shadows in chapter one. We have said that we must be careful to distinguish between a need as such, which is a thought, from what is needed, that is the *satisfier*. Within literature about needs, the latter is generally defined as a resource (object or action) that has the function of satisfying a need. But what exactly is the satisfier from an ontological standpoint?

Taking advantage of our analysis of intentionality, now we are able to give a straight answer to such a question. The satisfier is nothing but the state of affairs that meets the condition of satisfaction identified by the propositional content expressed by an instrumental need seen as a thought. As we remember, in section 2.2 we have stressed that not only states of affairs, but also events can be seen as entities that make propositional contents true or, more generally, satisfy thoughts' satisfaction conditions. Moreover, we have pointed out that states of affairs or events might be seen as complex entities which our thoughts are about in terms of reference intentionality (RI). Thus, needs' satisfiers can be seen also as entities that play the role of intentional object. Let us consider an example: take the intentional sentence 'John needs dynamite to steal money from the bank vault'. John's need will be met, let's say, by a certain event. Events *qua* complex entities are constituted by particulars that instantiate properties at a certain time. More precisely, the event at stake will be constituted by particular dynamite that instantiates the property 'being detonated' occurring at a certain time, let's say on November 11, 2020'. Such an event is not just the entity that meets the condition of satisfaction of John's need, but also the complex entity that plays the role of

intentional object as regard to John's need[39]. Note also that John's satisfier related to his need is the event such that if realised, allows to bring about the accomplishment of John's end goal, which is another event, that is 'stealing money from the bank vault'. In this sense, John's need is an instrumental goal whose existence depends on John's end goal. In other words, John would not need dynamite, if he did not have the goal to steal money from the bank vault. However, it should be stressed that, in this case, John's instrumental goal is a necessary, but not sufficient, condition with regard to the end goal achievement, in fact, many events should take place to realize the end goal, for example, John should be able to escape before the police come to arrest him.

[39] Note that, according to the non-structuralist view, events can even be seen as a basic type of particulars (Davidson, 1980). As we shall see, the non-structuralist view corresponds to DOLCE's position about events.

3. The ontological stance

3.1 Ontology and Metaphysics

We have started out our analysis of the notion of need prompted by the overall context of public services design. In the introduction, we have stressed that the area of Information Science recently got interested in understanding needs and using this notion as a guiding conceptual device to represent and manage PA's services, where the citizen-focused approach requires the individuation of different types of needs. We have also pointed out that studying needs-driven services implies taking into consideration, among others, cognitive aspects (people's needs, beliefs, desires, goals) for the purpose of understanding and communicating relevant knowledge about what we aim to design. To account for such a cognitive perspective, we have adopted a mental framework on needs, seeing 'to need' as an intentional verb that describes thoughts about entities that play the role of intentional object. Furthermore, in the closing of the 2nd chapter, we have suggested in which sense needs, as mental attitudes, can be distinguished from their satisfiers. Now, we are going to deepen the cognitive view about needs by complementing the theory of intentionality with BDI (belief-desire-intention) models that have been developed for reasoning and planning with mental states, attempting to provide an ontological analysis useful to set up needs-driven services design. But before we do that, we have to make explicit some ontological and metaphysical assumptions that we embrace in this work. In particular, we will ground the analysis on DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering), a foundational ontology that has been widely used in the field of Knowledge representation. The choice of DOLCE (Masolo, Borgo, et al., 2003) is motivated by its ontological commitment to its being tailored to commonsense representations of cognitive agents, rather than to an objective 'reality' prescribed by science. This feature brings to the core of DOLCE the importance of modeling mental and social realms, and thus makes it particularly suitable for our purposes. Note that DOLCE makes extensive use of philosophical notions. Hence, first of all, we would better review some well-established themes concerning contemporary ontology. In the present chapter, we will then focus on philosophical ontology, before turning to ontology in Information Science. Finally, we will introduce DOLCE's theoretical framework.

To begin with, note that in the philosophical literature the term 'ontology' is often, if not always, flanked by the term 'metaphysics', and sometimes they are used interchangeably. Historically, as is well known, the term 'ontology' has been coined by Rudolf Göckel in his *Lexicon philosophicum* (1613) and, independently, by Jacob Lorhard in his *Theatrum philosophicum* (1613), whereas the term 'metaphysics', which literally means after 'physics', has been introduced by Andronico of Rhodes in the first century B.C to refer to what Aristotle called 'first philosophy'. Nowadays, some scholars see ontology as a part of metaphysics (Berti, 2003), in the sense that the former is included in the latter. According to others (Mulligan, 2000), it is rather the opposite, namely, metaphysics is conceived of as part of a wider discipline that is ontology. Other times, ontology and metaphysics, although seen as strongly related, are kept separate to the effect that these disciplines perform different philosophical tasks. As Varzi (2011) has pointed out, metaphysics can be conceived of as an analysis that aims at defining what objects are, while ontology concerns the question of the existence of objects, in other words, whether there are such objects. Therefore, with respect to an object X, if on the one hand, metaphysics attempts to answer the question 'What is an X?', on the other, ontology tries to provide an answer to the question 'Is there an X?'. Moreover, some philosophers see the ontological question as preliminary to the metaphysical question, while for others it is just the opposite (cf. Varzi, 2008). The former group believes that we should start with establishing what really exists, drawing up a kind of inventory about the entities of the world, and only then we can argue about the nature of such entities. Take for example numbers. Many philosophers will be ready to accept that there are numbers. Nonetheless, they might disagree about the metaphysics of such entities. For instance, one could argue that numbers are *abstract individuals* that encode certain properties fixed by certain mathematical axioms, others might hold that numbers are *classes* that satisfy such properties (Varzi, 2011). The position espoused by the latter group of philosophers instead, namely those who see the metaphysical question as preliminary to the ontological question, can be represented by a philosophical sensibility that is akin to that of Meinong, "whereby any inquiry concerning the being so, or such-and-such, of a thing (its *Sosein*) has priority over the question of its being there (its *Dasein*)" (Varzi, 2011, p. 419). In any way, regardless of either ontology has priority over metaphysics or *vice versa*, one might object to both views that keeping separate ontology and metaphysics is not a feasible option. For example, being limited to state the existence of certain entities without explicitly declare what are such entities are is a vain way of speaking (Bianchi & Bottani, 2003). A biologist could believe to be on the trail of a newly discovered species of birds, but in order

to hold that such species is actually new, they should be able to provide a characterization of these birds that is accurate enough to distinguish it from already existing species. For the same reason, one could say that suggesting a metaphysical characterization of an entity without assuming its existence entails an empty talk, since first we should guarantee that such an entity actually exists. Yet, the criticism against the possibility of drawing a sharp distinction between ontology and metaphysics can be legitimately rejected, for different reasons, by both positions. For example, those who underpin that the ontological question is preliminary to the metaphysical question might highlight the fact that sentences related to our scientific theories are made true by entities whose existence is consistent with different metaphysical characterizations. Going back to the numbers example, Varzi points out that:

> For most mathematicians, numbers are the referents of certain expressions and their fundamental properties are fixed by certain axioms […] What truly matters — one could say — are the principles and laws that govern our favorite theories, whose truth depends on the existence of the entities they refer to or quantify over. Then one is free to go further and specify the metaphysical make-up of such entities. But that is an optional task, not a prerequisite for their legitimate inclusion in our inventory of the universe (Varzi, 2011, pp. 412–413).

Philosophers that adopt such a view assume that, contrary to Meinongian theories, the ontological question of being has a univocal meaning, that is the meaning expressed by Quine's slogan on the ontological commitment, according to which, *to be is to be the value of a bound variable*. This position holds that, while we could disagree on metaphysics, we should, at least, agree on such commitment, since the question of being has only one meaning. Ontology is seen as the hard core of philosophical investigation, which has to be followed by the metaphysical analysis as a further refinement. Thus the priority of ontology with regard to metaphysics, as well as the distinction between the former and the latter, is ultimately motivated by the belief that 'existence' has such a univocal meaning. On the other side, those who support a Meinongian view might argue that it is reasonable to distinguish between metaphysics and ontology to the extent that nothing prevents talking about the nature of an object without assuming its existence, being the latter only one among different modes of 'being' (*Sein*). In this case, the priority of metaphysics with respect to ontology is motivated by the fact that an object is interpreted as the 'simple something' regardless of the fact that such an object exists or subsists.

Moreover, it should be emphasized that it is possible to make a further distinction between Descriptive and Revisionary metaphysics which in turn, depending on the assumptions about the relation between metaphysics and ontology, affects ontology itself. The distinction

between Descriptive and Revisionary metaphysics has been introduced by Strawson, who claims that "Descriptive metaphysics is content to describe the actual structure of our thought about the world, revisionary metaphysics is concerned to produce a better structure" (1964, p. 9). Let us get deeper into Strawson's definition. Starting with Descriptive metaphysics, we might say that it aims to describe the world as it is represented by what Strawson calls 'conceptual scheme', human ways of thinking that, roughly speaking, reflect our cognitive system. Given that conceptual schemes hinge on human cognition, they are not subjected to change throughout history. This 'immutability' is another way to introduce the subject of Descriptive metaphysics:

> The idea of a descriptive metaphysics might be assailed from another direction. For it might be held that metaphysics was essentially an instrument of conceptual change, a means of furthering or registering new directions or styles of thought. Certainly concepts do change, and not only, though mainly, on the specialist periphery; and even specialist changes react on ordinary thinking. Certainly, too, metaphysics has been largely concerned with such changes, in both the suggested ways. But it would be a great blunder to think of metaphysics only in this historical style. For there is a massive central core of human thinking which has no history--or none recorded in histories of thought; there are categories and concepts which, in their most fundamental character, change not at all (Strawson, 1964, p. 10).

This idea of metaphysics leads us to consider *things* and *events* as the most fundamental ontological categories of the world individuated by our conceptual schemes:

> We think of the world as containing particular things some of which are independent of ourselves; we think of the world's history as made up of particular episodes in which we may or may not have a part; and we think of these particular things and events as included in the topics of our common discourse, as things about which we can talk to each other. These are remarks about the way we think of the world, about our conceptual scheme (Strawson, 1964, p. 15).

As Urbani Livi (2003) has stressed, there is continuity in Strawson's conception of Descriptive metaphysics and a tradition of thought that starts with Descartes, passes through Kant, and arrives at idealism. Yet, nowadays, philosophers tend to put aside the transcendental-idealist framework of Strawson's idea of descriptive metaphysics and instead focus on its methodology, which arises from the analysis of the common-sense conception of the world expressed by natural language (Haack, 1979). On the other side, Revisionary metaphysics is particularly aware of the empirical results of natural science and seeks to take account of these results to give us an ontological view that is often far from the intuitive common-sense beliefs. To get a grip on the points made above we shall introduce the difference between a three-dimensional and a four-dimensional theory about objects (i.e. theories of objects' persistence through time), which might be seen as respectively consistent

with Descriptive and Revisionary metaphysics. Starting with Three-Dimensionalism, if we think about everyday life objects (e.g. persons, trees, tables, cars, etc.), common sense tells us that such objects are particular material entities extended in 3-D space, but not in time. From this perspective, an object is called 'endurant' or 'continuant'. Such object *persists* through time to the extent that at any given time of its existence it is 'wholly present'[40], that is, very roughly, all its parts are present. On the other hand, according to the Four-Dimensionalism theory, objects are also extended in time and are called 'perdurants' or 'occurents'. In this view, objects *persist* through time having different 'temporal parts'[41] at different times, thus at any given time only some of their parts are present. Intuitively, we can grasp what is a temporal part resorting to the following metaphorical picture:

> think of a film strip depicting you as you walk across a room. It is made up of many frames, and each frame shows you at a moment of time. Now picture cutting the frames, and stacking them, one on top of another. Finally, imagine turning the stack sideways, so that the two-dimensional images of you are all right-side-up. Each image of you in one of these frames represents a temporal part of you, in a specific position, at a particular location in space, at a single moment of time. And what you are, on this way of thinking, is the fusion of all these temporal parts (Emery et al., 2020).

Now, let's make an example that represents the alternative perspectives suggested by Three-Dimensionalism and Four-Dimensionalism. If we assume Three-Dimensionalism, we can imagine that the same entity performs different actions at different times. Thus suppose that, let's say, John is reading a book at time t_1, while he is mowing the lawn at time t_2. We can conclude that, trivially, the entity that is reading a book at t_1 is the same entity that is mowing the lawn at t_2, that is John, since he is wholly present at every time he exists. Yet, if we embrace Four-Dimensionalism, things change radically. The entity that is reading a book at t_1 and the entity that is mowing the lawn at t_2 are two different temporal parts of John, rather than being identical with John himself. As we can see, Four-Dimensionalism is quite counterintuitive when compared to Three-Dimensionalism, yet the former is more in line with a scientific outlook, such as the special theory of relativity, according to which time is a physical dimension like space, thus objects are extended both in space and time (Hales & Johnson, 2003). In this sense, we could say that a Descriptive metaphysical approach about material objects can be represented by Three-Dimensionalismin in its being closer to common sense, while Revisionary metaphysics is better represented and expressed through Four-Dimensionalism as far as it provides an image of material objects that, albeit clashing

[40] For a perspective about different conceptions of 'wholly present' see Crisp & Smith (2005).
[41] The *locus classicus* for the the definition of temporal part is Sider (2001).

with our pre-theoretical insights, is in accordance with a scientific perspective. At any rate, instead of just drawing a line between descriptive and revisionary metaphysics, we might assume continuity between them, stating that there "is no sharp boundary between Descriptive and Revisionary Metaphysics. Instead, we arrive at Revisionary Metaphysics on the basis of a further need to alter our common sense based conceptions" (Haack, 1979, p. 46). Obviously, there would be domains of knowledge, such as the case of the abovementioned theory of relativity, in which Revisionary Metaphysics is *tout court* more compelling than Descriptive Metaphysics. But the converse can also happen. For example, describing the world as it 'appears' according to human cognition can be useful as regards Cognitive Sciences development, which has always paid attention to simulate and reproduce human mind's skills like problem-solving and action planning, not to mention the interest of Software Engineering and Robotics towards Folk Psychology. In this respect, Descriptive Metaphysics is a powerful tool to analyze those conceptual schemes that, according to Strawson, shape the way we see the world. In any way, depending on which metaphysical approach better complies with our needs to understand reality, the ontological categories that are adopted might be very different. For example, note that we commonly perceive and conceptualize everyday life material objects as different from *events*, like for example a football match. Descriptive Metaphysics allows accounting for such difference by seeing material objects as *endurants* and events as *perdurants*. Yet, according to a view that is consistent with Revisionary Metaphysics, objects, as well as events, are extended in time and space, thus both are *perdurants.* In other terms, there is no distinction between objects and events (Varzi, 2002).

Another point to consider within the contemporary literature about ontology is the meaning of the locution 'formal ontology'. First of all, it should be noted that formal ontology has a strong relationship to formal logic. For instance, for Mulligan (2000) formal ontology stands to ontology and metaphysics as logic and formal semantics stand to the theory of meaning. Along this line, Varzi (2008) suggests that formal ontology stands to reality as formal logic to the truth. In the sense that just as logic is not concerned with establishing what makes statements true or false, but is limited to study valid arguments taking into consideration the relationship holding between truth values of such statements, so formal ontology does not deal with determining what entities exist, but is focused on studying the relationship between entities in virtue of their conditions of existence. Examples of such relations are ontological dependence and parthood relation. In such cases, subjects like set theory, mereology, topology, and mereotopology can be considered expressions of formal ontology studies

(Mulligan, 2000). More generally, we might say that formal ontology has to do with the analysis of those ontological categories that are abstract enough to be universally applicable; according to this interpretation, "formal ontology is formal in the sense used by Husserl in his *Logical Investigations*. Being 'formal' in such a sense therefore means dealing with categories like *thing*, *process*, *matter*, *whole*, *part*, and *number*" (Poli, 2003, p. 185). In this respect, formal ontology can be distinguished from 'material ontology', which is related to the study of specific domains, including the ontology of physics, mathematics, cognitive science, etc. To this extent, Smith claims that the "relation between formal and material ontology is in this respect analogous to that between pure and applied mathematics" (Smith, 2003, p. 39). Moreover, we should be careful not to confuse formal ontology with 'formalized ontology'. In a nutshell, every type of ontology, including formal ontology, can be 'formalized' when we attempt to make clear ontological assumptions resorting to the syntax and semantics of a formal language:

> Formalized ontology presents two main variants, depending on the preferred formal environment. Its mainstream acception lies within a logical version of formal ontology; the other version being characterized by the use of other mathematical environments (algebraic and/or geometrical). In its turn, the logical interpretations of formal ontology can be further subdivided between those working with classical or otherwise 1st order predicate logic and those working with 2nd order logic (Poli, 2003, pp. 185–186).

However, it should be stressed that often the borders between formal, formalized, and material ontologies are difficult to draw given that many themes and perspectives tend to overlap (Masolo, Oltremari, et al., 2003; Varzi, 2008). The same can be said for the connection points and divergence between Descriptive and Revisionary Metaphysics. The various senses of ontology and metaphysics that have been reviewed are 'terms of art', and as such should be taken as guidelines to keep track of different ways to deal with the complexity and richness of contemporary philosophy.

3.2 Applied ontology

Outside philosophy, Information Science uses the word 'ontology' to refer to a wide range of methodologies, languages, and applications designed to improve the capabilities of recording and organizing human knowledge. As Smith has pointed out:

> the term 'ontology' has gained currency in recent years in the field of computer and information science in a way which has led to a veritable explosion of publications and conferences on the topic of ontology. A term which has become popular especially in domains such as knowledge engineering, natural language processing, cooperative

> information systems, intelligent information integration, and knowledge management (Smith, 2003, p. 22).

Historically speaking, for the first time within the computer science literature, the term 'ontology' has been introduced by S. H. Mealy as regards the basic foundation of data modeling (Mealy, 1967). In this paper, Mealy distinguishes between three domains, that is the real world, ideas about it, and symbols on paper or other storage media and defines data as "fragments of a theory of the real world, and data processing juggles representations of these fragments of theory"(Mealy, 1967, p. 525). Commenting on the work of Mealy, Smith highlights that genuine ontological questions like 'what is data?' 'In which way does data relate to the world?' have arisen "in reflection of quite specific practical problems which needed to be faced in the late 1960s by those working in the field of database management system"(2003, p. 23). It is above all in the data modeling community that ontology has found its place, with the goal of integrating automated systems that are already available:

> Different groups of data- and knowledge-base system designers have for historical and cultural and linguistic reasons their own idiosyncratic terms and concepts by means of which they build frameworks for information representation. Different databases may use identical labels but with different meanings; alternatively the same meaning may be expressed via different names. As ever more diverse groups are involved in sharing and translating ever more diverse varieties of information, the problems standing in the way of putting such information together within a larger system increases geometrically. It was therefore recognized early on that systematic methods must be found to resolve the terminological and conceptual incompatibilities between databases of different sorts and provenance. (Smith, 2003, pp. 35–35).

Although there are many definitions of what an ontology is in Computer Science and Artificial Intelligence (Gómez-Pérez et al., 2004), we might say that, generally, within these fields, the word 'ontology' denotes computational artifacts, the means to model and represent through formal language domains of interest for a pragmatic purpose (e.g. the structure of a company with its employees and relationship); in this context 'entities' are information objects whose meaning is made explicit in order to get shareable knowledge (Guarino et al., 2009). Formerly, the use of ontologies in Information Science has been focusing above all on aspects related to the codification and representation of information, yet the massive growth in information and communication technologies "in recent years has led to a new focus on information content, and to an increasingly interdisciplinary approach to research and development activities in these fields" (Guarino & Musen, 2005, p. 1). In this respect, "some ontological engineers have recognized that they can improve their models by drawing on the results of the philosophical work in ontology carried out over the last 2000" (Smith, 2003, p. 83). Along these lines, the perspective of Applied Ontology, a branch

of Artificial Intelligence, makes use of an interdisciplinary approach based on Computer Science, Philosophy, Linguistics, Logic, and Cognitive Science, with the conviction that, in order to achieve well-founded models of the reality we are interested in studying, first of all, we should take into consideration the *content*, that is the *semantic aspect* of what we would like to represent[42]. Applied ontology, *qua* ontological analysis focused on content, has to be distinguished from its applications[43], that is the analysis is independent of different technologies developed by Information Science to represent such content. Before designing and implementing an information system, the conceptual modeling phase is of paramount importance and such phase requires looking beyond data to that physical and social world in which we live. Hence the need to employ ontological categories capable of accurately describing reality. In short, Applied ontology is a research perspective that promotes formal theories that include axioms that constrain the meanings of the terms used to talk about entities and relations related to a certain 'portion of reality', that is any domain we are interested in modeling. The goal is to make explicit the intended meaning of the terms we use for recording and managing information to facilitate the 'meaning negotiation' between different system designers, thus promoting cooperation between agents, be they human or artificial. To achieve such a goal it is necessary to provide ontologies that make use of categories general enough to be appliable to different domains. In this respect, the so-called 'foundational ontologies' are the best candidates, as these deal with broad categories including objects, events, qualities, and relations such as constitution, participation, dependence, part-of. Besides, foundational ontologies are axiomatic theories, which reduce the risk of inconsistencies and guarantee semantic transparency. Foundational ontologies must be distinguished from 'lightweight ontologies', which are mostly taxonomies of terms associated with definitions, and are designed to represent specific domains of knowledge where the meaning of terms is shared by a certain community; thus, in this case, there are no particular issues with the meaning negotiation (Gaio et al., 2010). A type of foundational ontology that has been successful over time for its applications is DOLCE, whose acronym stands for 'Descriptive Ontology for Linguistic and Cognitive Engineering'. As its name reflects, DOLCE is a descriptive ontology in a sense that is perfectly in line with Strawson's conception. In this respect, DOLCE is described by its authors as follows:

> A descriptive ontology aims at capturing the ontological stands that shape natural language and human cognition. It is based on the assumption that the surface structure of natural

[42] For an overview on Applied ontology see Munn & Smith (2008).
[43] See Guarino (1998).

> language and the so-called commonsense have ontological relevance. As a consequence, the categories refer to cognitive artifacts more or less depending on human perception, cultural imprints and social conventions (Masolo, Borgo, et al., 2003, p. 7).

Furthermore, being an axiomatic theory (expressed in First-order logic) that takes into account wide ontological categories (e.g. objects and events) and relations (e.g. dependence, part-of, constitution) general enough to be applied to several domains, DOLCE can be classified both as a *formalized* and a *formal* ontology as defined in section 3.1. DOLCE has been developed within the WonderWeb project. The main aim of such a project was to design a 'library' of foundational ontologies, related to each other to make different ontological perspectives and formal consequences explicit, thus offering the possibility to adopt a wide range of modules in the face of heterogeneous contents, rather than imposing or assuming a standard ontology valid for every content (Masolo, Borgo, et al., 2003). A library of foundational ontologies so conceived can be applied to a wide variety of specific domains for modeling purposes, bringing out the relevance of foundational ontologies for lightweight ontologies as well as their complementarity. Concerning DOLCE, note that the rationale for choosing a descriptive perspective on ontology is given also by the fact that the World Wide Web has a social nature, in this respect focusing on ontological categories underlying natural language and commonsense is very relevant (Masolo, Borgo, et al., 2003). In the next paragraph, we are going to introduce an informal characterization of the ontological choices that are at the basis of DOLCE.

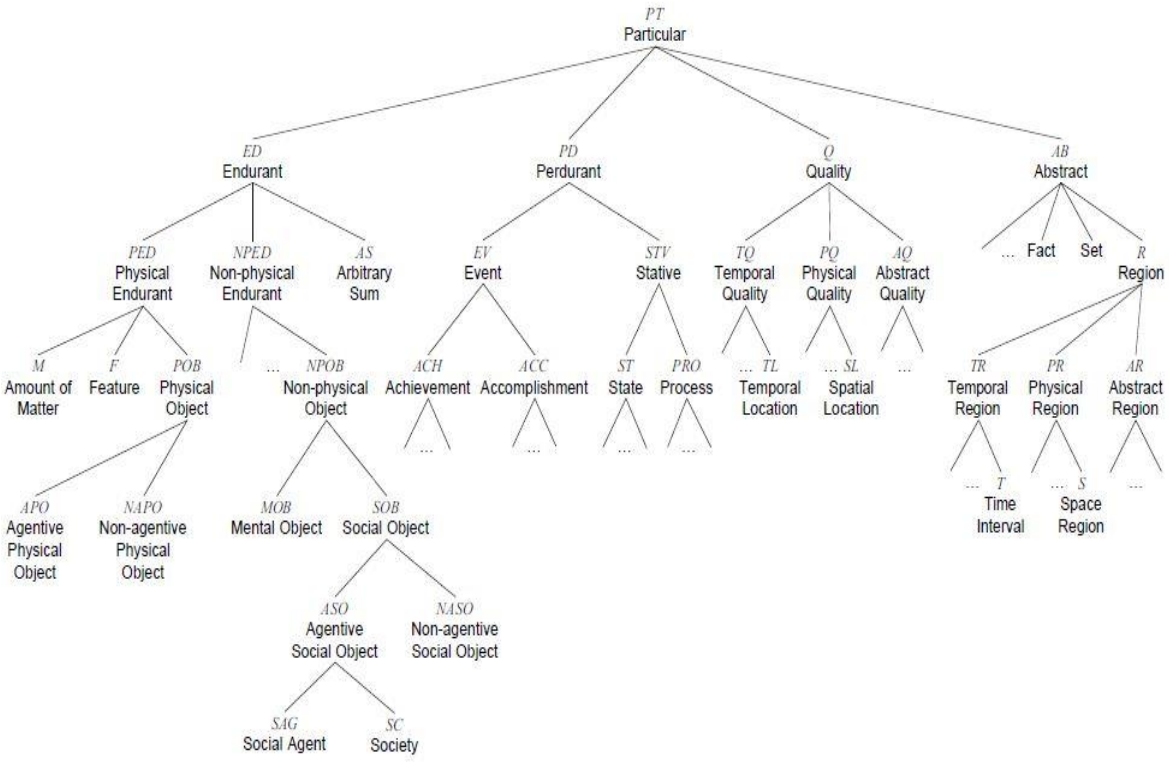
3.3 DOLCE

The first thing to notice is that DOLCE is an ontology of *particulars* or *individuals*, that is its domain or universe of discourse (i.e. the entire range of entities that are assumed to exist) includes only particulars, which are ontologically characterized as just opposed to universals. More precisely, particulars and universals might be distinguished by means of the primitive relation of *instantiation*: particulars are entities that cannot be instantiated, such as Bill Gates, the Empire State Building, the Mona Lisa, while universals are entities that can have instances, like the property of 'being red' or the relation 'being taller than'. Thus, for example, while the particular 'Cristiano Ronaldo' is an instance of the property 'being a soccer player', Cristiano Ronaldo can neither be an instance of himself nor be instantiated by any entity. However, this does not rule out that universals "do appear in an ontology of particulars, insofar they are used to organize and characterize them: simply, since they are not in the domain of discourse, they are not themselves subject to being organized and

characterized" (Masolo, Borgo, et al., 2003, p. 13). Another relevant ontological choice concerning DOLCE is the endorsement of the so-called 'multiplicative approach', that is to say, different entities might be localized with respect to the same spatio-temporal region. Take for example a vase and the amount of clay it is composed of. If we broke the vase, then the vase would cease to exist. Yet, intuitively, we would not tend to say the same for the clay, namely the latter still exist. So the vase is made of clay, but the clay is not the vase itself. The vase and the amount of claim are different co-localized entities to the extent that they can instantiate incompatible properties. This being said, DOLCE presents four fundamental categories of particulars that are *endurant*, *perdurant*, *quality*, and *abstract*. We have already briefly talked about the philosophical difference between endurants and perdurants, and we have seen that such a difference depends on the way in which these entities persist through time. That is, while the former are said to be 'wholly' present, the latter are only, we might say, 'partially' present. According to DOLCE, being 'wholly' present means that an entity persists through time to the extent that at any given time of its existence all its proper parts are present, whereas being 'partially' present means that an entity persists through time cumulating different 'temporal parts', that is it at any given time some of its proper temporal parts might be not present since such parts were present in the past or will be present in the future. For instance, the ship on which Maria is traveling, being wholly present, is an endurant, while Maria's traveling is a perdurant, it has different temporal parts at different times. So perdurants, as opposed to endurants, have temporal parts. The former are entities which are said to 'happen in time' while the latter are entities that 'are in time', they exist as a whole as time goes by. This means that endurants can undergo genuine changes through time, for example, the very same entity, let's say a house, might instantiate *incompatible* properties at different times, that is 'being white' and 'being yellow' at t_1 and t_2 respectively. On the other hand, there is little point in stating that perdurants undergo a genuine change in time since for a given perdurant, there are always different temporal parts of it that exhibit properties at different times; in other terms, there is no incompatibility between properties given that such properties refer to different temporal parts. Consider a classic concert and its movements, there may be many different speeds in one piece of music, for example, it can be 'very fast' at t_1, 'slow' at t_2 and 'moderate' at t_3, these are all properties related to different temporal parts of the concert. The relation between endurants and perdurants is called 'participation', for instance, a person, which is an endurant, participates in a football match, which is a perdurant. We now come to the other two DOLCE's categories, which are *quality* and *abstract*. Qualities are particulars that

inhere in entities and exist as far as such entities exist. There are many types of qualities including, color, size, smell, shape, etc. Qualities are, in the final analysis, all those entities that we are able to perceive or measure[44]. Qualities have to be distinguished from their *values.* For example, the color of a particular entity, which is a quality, and the particular shade of such color, which is the value. The latter is called 'quale' and represents the position of a particular quality within a given 'conceptual space'[45]. Note that, given that qualities inhere in specific individuals, two different individuals cannot have the same quality. But then how can we explain the fact the two entities, let's say two blue cars, have exactly the same color? In general, claiming that two particulars have the same quality is equivalent to saying that such qualities, which are different, share the same position within the conceptual space, that is they have the same value or quale. Moreover, each quality type is associated with a *quality space* characterized by its own structure. For example, the metric linear space is a quality space related to the quality type 'length'. According to DOLCE, quality spaces are examples of abstract entities, more precisely they are kinds of *quality regions*, or more simply *regions.* Abstract entities are a type of entities that exist outside space and time, so they do not have temporal or spatial qualities. Other types of abstract entities mentioned in DOLCE, by way of illustration, are facts and sets. The taxonomy of DOLCE is set out below:

[44] Note that 'quality' is often used as synonymous with 'property', but this is not the case in DOLCE.
[45] This notion goes back to Quine (1969) and has been taken up by Gärdenfors (2000).



Source: (Masolo, Borgo, et al., 2003, p. 14)

Finally, it should be noted that recently some of the ontological choices made in DOLCE have been revised to lay the foundation for a new version of the ontological framework. The theoretical revision has affected only a fragment (i.e. the core categories) of the whole ontology, and for this reason, it has been dubbed DOLCE-CORE (Borgo & Masolo, 2009). This one is still an ontology of particulars or individuals, yet its domain of discourse is limited to what is called 'temporal particulars', in other terms all entities that exist in time. Temporal existence is expressed by the binary predicate PRE (x, t) that stands for 'the entity x is present at t'. While within DOLCE entities such as quality spaces and regions are abstract entities (i.e. things do not exist in space and time), DOLCE-CORE sees them as temporal entities. Furthermore, here we can note the introduction of a new ontological category, which is that of *concept*, that is not included in DOLCE. Besides, the categories of endurant and perdurant are renamed to *object* and *event* respectively. The new most basic ontological categories of DOLCE-CORE are six, that is objects, events, individual qualities, regions, concepts, and arbitrary sums.

As we shall see in the next chapter, the category of 'concept' is relevant for the development of our theoretical perspective on intentionality and BDI, especially for understanding the theory of roles that we have espoused. In fact, roles are a *subclass* of concepts, that are

treated in DOLCE-CORE following the assumptions made in (Masolo et al., 2004). Here the basic idea about roles that have been introduced in the second chapter, that is roles seen as anti-rigid and founded properties, is developed in a perspective that takes into consideration social ontology, intentionality, and semantic aspects toward a definition of the notions of *social concept* and *social role* by using the formal apparatus of DOLCE. Ontologically speaking, social concepts are *particulars*[46]. Descriptions, and as consequence concepts that are defined by descriptions, are created, starting at their first encoding in a public language by communities of intentional agents. Different descriptions expressed in different languages can have the same content. Descriptions might be encoded in different physical supports, such as texts, but also human memory may count as a support (e.g. oral transmission). The existence of descriptions depends on such supports, that is a description exists as long as its support exists. This means that descriptions, as well as contents, have temporal extensions, thus they can be present or not at a certain time. Concepts defined by descriptions can *classify* different kinds of entities, for example, objects as well as events. Concepts classify entities that satisfy all the constraints in the concept definition. Furthermore, the classification relation is associated with a time parameter that identifies a specific interval in which the classified entity satisfies the definition, more formally cf (x,y, t) stands for "the social concept x classifies the entity y at time t". For example, the current Italian Constitution "can be seen as a description defining the current concepts of Italian President, Italian government, Italian Prime Minister, etc. Berlusconi during 2003 and D'Alema 4 years ago are classified by the latter concept" (Masolo et al., 2004, p. 271).

[46] In Masolo et al. (2004) concepts, as well as roles, have been 'reified' to be able to predicate on them using First-order logic. Conceptually speaking, roles are still properties. However, in order to avoid second-order quantification, roles have been treated as 'first-class citizens'.

4. Goals to achieve

4.1 Bratman's theory of intention

In this chapter, we are going to introduce our theoretical proposal for representing an ontology of mental states, which includes needs as essential elements to cope with services design. To this aim, as we already mentioned, we will attempt to integrate the previous analysis about needs and intentionality with the context of the BDI (Belief-Desire-Intention) model. The BDI theory has its roots in the philosophy of action, which deals with themes including agency, action plan, folk psychology, intentionality, and mental attitudes. More generally, the BDI theory is concerned with *practical reasoning*, which involves, as Wooldridge has pointed out, thought processes that are manifested in decision-making:

> Human practical reasoning appears to consist of at least two distinct activities. The first of these involves deciding what state of affairs we want to achieve; the second process involves deciding how we want to achieve these states of affairs. The former process - deciding what states of affairs to achieve - is known as deliberation. The latter process - deciding how to achieve these states of affairs - we call means-ends reasoning (Wooldridge, 2000, p. 21).

The research perspective that underpins the BDI literature consists in designing automated systems based on human abilities to reason and make decisions about goal achievements. Different logics and software implementations have been inspired by BDI. However, it should be stressed that the BDI model in itself is just a philosophical theory about practical reasoning. In this respect, Michael Bratman's work related to the notion of 'intention' represents an indispensable starting point. So, first of all, let us present the main results of Bratman's theory of intention.

In the philosophical literature Donald Davidson (1980), as well as Daniel Dennet (1987), have placed desires and beliefs at the center of the description of human reasoning, demonstrating how such mental attitudes turn out to be crucial for weighing up agents' alternative choices. In this sense, Bratman's contribution (1983, 1987, 1990) consists in pointing out that the pair belief-desire is not sufficient to account for sketching out a model of human agency. According to the belief-desire model, the notion of intention can be derived from the relation between desires and beliefs. Bratman (1984) rejects such a view, by adding to beliefs and desires the intentions, therefore interpreting them as three different

primitive concepts. From here, the origin of the model that takes the name of BDI. Bratman highlights that the term 'intention' is used to refer to both *actions* and *mental states*. For example, John might intentionally kick the ball, or he might just intend to do so. In the former case, the intention emphasizes an intentional action, while in the latter case the intention exemplifies a mental state[47]. The difference is that which passes from *doing things* intentionally and just *being committed* to doing certain things in the future. Clearly, these two meanings of 'intention' are closely linked. Intuitively, if I performed a certain action intentionally, then I would intend to perform such action (i.e. I have a mental state of intention about it). But, as we shall see, Bratman's analysis of intention shows that things aren't that easy. To begin with, Bratman's theory is focused on the so-called 'future-directed' intentions (i.e. mental states about some future actions) and their cognitive role related to practical reasoning. Thus hereafter we shall refer to such type of intentions. For Bratman future-directed intentions represent, so to speak, the core of human agency:

> We frequently settle on an intention concerning the future and then proceed to reason about how to do what we intend. Today I decided to go to Monterey tomorrow. Now I must figure out how to get there. In such reasoning my future-directed intention to go to Monterey functions as an important input; and its role as such an input is, I believe, central to our understanding of intention (Bratman, 1990, p. 17).

Hence intentions are a sort of 'programmatic' mental states, and as such, they are clearly distinguished from desires, in the sense that while intentions must be *consistent* with respect to certain *beliefs*, desires can be *inconsistent*. For example, if Giorgio intends to take a bus and he knows that he has bought a ticket valid for a single journey on the bus or the underground, he should not simultaneously intend to take the underground. Note that if Giorgio believed that both intentions are jointly realizable, then he would be criticized for being irrational. On the other hand, we typically desire things that are inconsistent with respect to our beliefs without running the risk of accusations of irrationality. For example, Giorgio could desire to buy a Ferrari despite he knows that he cannot afford it. Moreover, nothing prevents us from desiring different things simultaneously, for instance, Maria might be torn between desiring to go to the opera and desiring to go to the cinema on the same night. To some extent, intentions and desires are similar, given that both can be seen as types of *pro-attitudes*, that is mental attitudes that, according to certain beliefs, play a *motivational role* with respect to performing a certain action. Yet, while a desire represents just a

[47] It should be clear that intentions must not be confused with intentionality *qua* the property of thougts of being about objects. Intentions are just a type of intentional mental states. In what follows such distinction should be made clear by the context.

‘potential influencer’ of agency, an intention can be seen as a ‘conduct-controlling’. In other words, intentions entail a strong constraint on conduct:

> For example, my desire to play basketball this afternoon is merely a potential influencer of my conduct this afternoon. It must vie with my other relevant desires - say, my desire to finish writing this paper - before it is settled what I will do. In contrast, once I intend to play basketball this afternoon, the matter is settled: I normally need not continue to weigh the relevant pros and cons. When the afternoon arrives, I will normally just proceed to execute my intention. My intention is a conduct-controlling pro-attitude, not merely a potential influencer of conduct (Bratman, 1990, p. 22).

So, to understand what intentions are, it seems necessary to focus on the relationship between intentions, beliefs, and a certain requirement of consistency. To evaluate such a relationship, it is useful to underline the role of intention within *plans*. Note that in the literature about BDI the word ‘plan’ has a twofold meaning. On the one hand, a plan can be considered as a kind of ‘recipe’ for carrying out instructions to perform a sequence of actions (Bratman et al., 1988). On the other hand, a plan is a mental state on a par with intentions and desires. The latter sense of plan is what Bratman is interested in to illustrate the role of intention. This being said, intentions represent fundamental elements to coordinate plans, intentions are “so to speak, the building blocks of such plans; and plans are intentions writ large” (Bratman, 1987, p. 8). So, it is thanks to intentions that human beings are able to structure plans to achieve complex goals over time. But to ensure that a plan could work, such a plan must be, at the very least, consistent. Bratman distinguishes between *weakly consistent* and *strongly consistent* plans (Bratman, 1984). We might say that weakly consistent plans do not entail that all intentions are consistent with a set of beliefs, while strongly consistent requires to meet such a condition. These notions of consistency represent, so to speak, two different standards by which to measure human rationality with respect to reasoning. Bratman provides an example to illustrate the point (Bratman, 1984). Imagine that an agent, let’s call him Paul, is ambidextrous and can play two videogames at the same time. Each game consists of shooting at one target, so we have two targets to be hit, let’s say $target_1$ and $target_2$. Paul’s goal is just to win one of two games. Furthermore, Paul knows that hitting a target is a very difficult task and that the two games are so linked that it is impossible to hit both targets. That is, Paul knows that, if he was about to simultaneously hit both targets, the games would shut down, hence he would lose. Despite this, Paul decides to play adopting the strategy of hitting both targets. Suppose that Paul succeeds in hitting $target_1$. Now, did Paul intend to hit $target_1$?

According to Paul's strategy, he intends to hit target$_1$ as much as he intends to hit target$_2$. Thus stating that Paul intends to hit target$_1$ is quite misleading. Furthermore, given that Pauls knows that he can't hit both targets, Paul's intentions are inconsistent with respect to his belief. Hence, following the strongly consistent view, Paul's attitude is irrational. But intuitively, it does not seem that Paul may be charged to be irrational. In fact, Paul's strategy aims to maximize the chances of victory, assuming a certain probability of losing in case he hits both targets. So, with this example, Bratman suggests that the strongly consistent view is too demanding to represent a good model of rational agency. After all, the weakly consistent view is more suitable for capturing the 'flexibility' of human reasoning.

Another relevant aspect of Bratman's theory is that, typically, we do not *intend* the 'side effects', the mere c*onsequences* of all that *we do intentionally*. Bratman (1990) gives the example of a military strategist who might intend to bomb the enemy's munitions' plant, despite knowing that next to the plant there is a school and so the bombing would cause the death of many children. The military strategist's goal is to weaken the enemy, cost what it may. In any way, the strategist doesn't *intend* to kill the children. The rationale behind Bratman's observation is that intentions play a *specific role* in *practical reasoning*, that is they act as *input* to generate *further reasoning*. In the example, if the bombing 'miraculously' did not cause the death of children, but only the destruction of the munitions' plant, then the strategist would be satisfied with this result and his goal would be achieved. So the strategist did not properly intend to kill the children. Yet, take the example of a terrorist that *intends* to bomb the school to kill the children and thereby terrorize the enemy's population. In this case, if the bombing did not cause the death of children, the terrorist would not give up. He would figure out a new way to kill the children.

As is clear from the above, intentions are essential elements in practical reasoning, especially with regard to planning. Plans have two fundamental characteristics, namely, they are *partial* and present a *hierarchical structure*:

> When I decide today to go to Monterey tomorrow, I do not settle all at once on a complete plan for tomorrow. Rather, I decide now to go to Monterey, and I leave till later deliberation about how to get there in ways consistent with my other plans. Second, my plans typically have a hierarchical structure. Plans concerning ends embed plans concerning means and preliminary steps; and more general intentions embed more specific ones. As a result, I may deliberate about parts of my plan while holding other parts fixed. I may hold fixed certain intended ends, while deliberating about means or preliminary steps (Bratman, 1990, p. 19).

The human mind has limited computational power. In addition, we live in a physical and social dynamic environment where it is difficult to foresee what will happen. The

environment pushes us to make decisions quickly, often appealing to cognitive biases (some of which are allegedly adaptative in terms of evolution). As a matter of fact, agents are resource-bounded in a double sense: a) they have limited access to information that could be relevant for the choice; b) information processing has a cost in terms of computation time and memory space; namely, in order to make an inference, agents have at their disposal limited time and memory space. Reasoning takes time and, in this regard, Bratman et al. (1988, p. 4) state that "the more time spent on deliberation the more chance there is that the world will change in important ways that will undermine the very assumptions on which the deliberation is". So, due to the challenges of a fast-changing environment and the limitations of decision-making processes, very detailed plans are not very useful in the long term. Yet, to achieve complex goals we have to think rationally, structuring all relevant actions step by step according to our intentions. For all these reasons, the nature of plans is inevitably partial and hierarchically structured. Within this framework, future-directed intentions play two relevant roles. On the one hand, intentions help to coordinate plans in a way that makes goals' achievements feasible, testing them through consistency. On the other hand, plans have to be filled in with sub-plans as time goes by until reaching the end goal, so a prior intention sets the stage for further intentions constraining the overall plan from the point of view of *means-ends* coherence. Thus, for example, suppose that Giovanni intends to go to Rome on Monday. Once that such prior intention has been settled, a means-end problem is posed: how does Giovanni get to Rome?

Now, imagine that Giovanni starts to detail the plan adding the intention to take the car to go to Rome on Monday, while knowing that he has promised to let his sister have the car on the same day. In this case, obviously, the plan will be inconsistent. Hence, Giovanni has to revise his intention, let's say, by choosing to get to Rome by train. This is a new intention which in turn will generate a new intention (e.g. buying train tickets online), and so on, up to to the end goal achievement. Then, provided that the overall plan is consistent, Giovanni will be ready to put his plan into action. Even if plans, as well as the intentions that constitute them, can be abandoned, revised, or resumed, plans "non-reconsideration should be treated as the 'default,' but a default that is overridable by certain special kinds of problems" (Bratman, 1990, p. 20). A planning agent that constantly reconsiders his plans would be irrational. Plans must have certain stability over time, but on the other hand, we must be ready to 'adjust' the planning activity for meeting changes in the world as well as changing beliefs caused by the acquisition of new pieces of information. The study of planning mechanisms represents a relevant theme within BDI literature. In any way, there is no room

here to account in detail for them[48]. We have just briefly sketched out the planning activity with the aim to emphasize the concept of intention. As well as plans, intentions have to be *persistent* or *stable* over time. This entails, for example, that Paul intends to realize the intention *p*, then he has to believe that *p* is possible or, at least, he should not believe that *p* is not possible. Furthermore, Paul believes that, given certain conditions, he will bring about *p*, that is, he is committed to bringing about *p*. On the contrary, generally speaking, according to Bratman an agent A abandons or drops an intention *p* in two cases: a) A believes that *p* is impossible to realize; b) A believes that *p* has been realized. To sum up, we can list the most important characteristics of intentions in the following way:

- Intentions are special kinds of *pro-attitudes.* In the same way as desires, intentions play a motivational role that leads to action. Yet, unlike desires intentions present a 'conduct-controlling' character. In other words, intentions entail a stronger constraint on conduct, a *commitment* to realizing certain actions;

- Intentions represent inputs to generate *further* reasoning. Once an intention has been settled, new intentions arise;

- Intentions give *means-end coherence* within the hierarchical structure of plans;

- Intentions have to be somehow *consistent*;

- Intentions have to be persistent over time.

Having said this, let us draw attention on how Bratman's conception of intention has been developed, becoming a reference point for various logical frameworks built on the BDI model. This will give us the opportunity to better understand the notions that have been just sketched, paving the way to our proposal.

4.2 BDI logics and philosophical remarks

Bratman's BDI model has been employed in AI as a philosophical layer to inspire the design of logical tools that capture the concepts of beliefs, desires, intentions, as well as the

[48] For more about plans see Bratman (1987) and Pollack (1992).

relationships among them, by means of a set of logical axioms and definitions. The aim was to dispose of a logical paradigm able to allow the implementation of BDI in software architectures (e.g. JAM[49], JASON[50], SPARK[51]) for reasoning and planning with rational agents' mental states. But what do we mean by the expression 'rational agent'?

In the context of AI, the term might refer to different kinds of entities, including people, social entities like a company, as well as software. In a nutshell, a rational agent is an entity that puts plans into action in the direction of goals achievements according to certain beliefs that he holds to be true:

> For example, if I have a goal of staying dry, and I believe it is raining, then it is rational of me to take an umbrella when I leave my house. Taking the umbrella will enable me to satisfy my goal of staying dry, and in this sense, it is in my best interest. You would still be inclined to refer to my behavior as rational even if I was mistaken in my belief that it was raining: the point is that I made a decision that, if my beliefs were correct, would have achieved one of my goals (Wooldridge, 2000, p. 1).

Rational agents can exist and operate within the 'real' environment (i.e. the physical and social world in which we live), as well as a software environment. So in the first case, rational agents' actions will be something like 'run on the beach' or 'catch the bus' whereas, in the latter case actions correspond to software commands (e.g. copy a file). Within AI, rational agents' behavior is usually described and explained appealing to Dennet's philosophical notion (1987) of *intentional stance*. Dennet denies that the alleged intentionality exhibited by thoughts is a genuine property of the mind. Ontologically speaking, there is nothing in the world that corresponds to such a property. Rather, intentionality is a linguistical tool, an 'abstraction' useful to ascribe mental states, notably desires and beliefs, to rational agents in order to predict their behavior. In this sense, the intentional vocabulary of mental attitudes can be ascribed not only to humans but also to computer programs with the purpose of representing and managing information (Wooldridge, 2000). Wooldridge and Jennings (1995) characterize rational agents suggesting the following properties: *autonomy*, *proactiveness*, *reactivity*, *social ability*. Autonomy is the agents' ability to take decisions independently of other agents, that is to say, the fact that an agent has their own plans through which they try to pursue goals. Proactiveness represents the fact that, in the words of Bratman (1984), we are *planning creatures* who exhibit a goal-oriented behavior. Rational agents make plans to achieve goals, so we expect that agents will try to put into practice such

[49] http://www.marcush.net/IRS/irs_downloads.html
[50] http://jason.sourceforge.net/wp/
[51] http://www.ai.sri.com/~spark/

plans. Reactivity entails that rational agents face the challenges of the environment modifying their plans if necessary. For example, if I intend to spend a day on the lake on Sunday but the forecasts say it will rain on Sunday, then I could decide to stay home and watch a movie. Finally, social ability is the capacity that is manifested in rational agents' cooperation, thus the negotiation skill that allows agents to mediate conflicts to achieve goals.

The picture about rational agents that we have just introduced represents the theoretical framework out of which BDI logics have been developed. The most influential logical approaches to BDI are undoubtedly due to Cohen and Levesque (1990) and to Rao and Georgeff (1991). Discussing BDI logics in detail falls outside our purposes[52], yet it is worth briefly dwelling on their major results with respect to the definition of the concept of intention. Beginning with Cohen and Levesque, their proposal is based on a propositional version of *dynamic logic*, employing a possible-worlds semantic. Each formula is evaluated with regard to some possible worlds and an index that represents a time point referred to such worlds. The logic adopts a linear-time structure, that is, time is extended infinitely into the past and future. A distinction is introduced between actions and events. Examples of events are 'moving an harm', 'exerting a force', 'uttering a word', etc. Actions refer to sequences of events, for instance, "a movement of a finger may result in a circuit being closed, which may result in a light coming on" (Cohen & Levesque, 1987, p. 13). Actions composition is obtained with the constructors of dynamic logic that is:

a ; a' : action a is followed by a'

a | a': either action a or action a'

a* : action a is repeated more than once

a? : action a is satisfied

The framework assumes four basic modal operators for representing agents' propositional attitudes (i.e. beliefs and goals) and sequences of events:

(Bel *i* p) : the agent *i* has the proposition *p* as belief

[52] For a discussion of BDI logics see Herizg et al. (2017) and Meyer et al. (2015).

(Goal *i* p) : the agent *i* has the proposition *p* as goal

(Happens a) : the action *a* will happen next

(Done a) : the action *a* has just happened

Agents' beliefs and goals are semantically modeled by means of accessibility relations to worlds that are assigned to each agent. Possible worlds represent sequences of events occurring in time. Agents' beliefs and goals are compatible only with those worlds in which propositions are true, that is to say, worlds that represent sequences of events that satisfy agents' attitudes. The approach employes the standard future time operators of temporal logic, that is ◊ (eventually) and □ (always). In addition, to represent propositions that are not true at time t, but will become true later than t, Cohen and Levesque introduce the operator (Later p). Finally, to model constraints on courses of events they use the operator (Before p q), which means that p will become true no later than q.

This being said, it should be emphasized that Cohen and Levesque, differently from Bratman, do not assume a primitive notion of intention. Rather, they seek to derive such a notion from the definition of different types of goals, that is *chosen goals*, *achievement goals*, and *persistent goals*. Hence intention turns out to be a 'composite concept' that specifies "what the agent has chosen and how the agent is committed to that choice" (Cohen & Levesque, 1990, p. 220). Within this framework, the notion of desire remains somehow in the background, in the sense that desires come into play only in the form of 'chosen goals' or simply 'goals'. A goal is nothing but a specific *desire* that the agent has *selected* from the set of their desires. Goals are therefore a subset of desires that have been chosen and, differently from desires, that do not have to be consistent; such goals are consistent by definition (i.e. once that a desire has been chosen, it rules out other desires, and becomes a goal to pursue). Achievement goals are those chosen goals that the agent believes to be currently not satisfied, yet such a goal can be satisfied in the future. An achievement goal (A-goal) is formally defined as follows:

$$(\text{A-Goal i p}) \leftrightarrow (\text{Goal i (Later p)}) \wedge (\text{Bel i } \neg \text{p})$$

A Persistent goal (P-Goal) instead is an achievement goal that the agent won't drop unless they believe that a) the goal has been achieved or b) the goal is impossible to achieve. The points a) and b) are formally captured by the second conjunct of the following definition of persistent goal:

(P-Goal i p) ↔ (Goal i (Later p)) ∧ (Bel i ¬p) ∧ [Before ((Bel i p) ∨ (Bel i □¬p))¬ (Goal i (Later p))]

Finally, an intention is a persistent goal with respect to which the agent has a *special* kind of commitment, that is the agent is committed to successfully having done the action that satisfies their goal. Moreover, in order to avoid the agent's commitment to actions that they might perform accidentally, the agent has to believe that they are about to do the intended action and then doing such action. More formally:

(Intend i p) ↔ (P-Goal i [Done i (Belief i (Happens p))? ; p])

Cohen and Levesque's approach succeeds in capturing many of Bratman's requirements to define the notion of intention. For example, persistence goals account for Bratman's suggestion that an agent A drops an intention *p* if A believes that *p* is impossible to realize or they believe that *p* has been realized. Furthermore, Cohen and Levesque's operator (Intend i p) provides conditions for representing the particular commitment to act that is entailed by intentions. Besides, by relying on persistent goals' definition, Cohen and Levesque (1990) have analyzed the relationship between a proposition *p* and its consequence *q*, demonstrating that if an agent A intends *p* and, at the same time, believes that *p* implies *q*, it does not follow that A intends *q*. This is a welcome result to account for what Bratman has called 'the side effects' of intention (recall the above-mentioned example of the military strategist who intends to bomb the enemy's munitions plant, but doesn't intend to kill the children).
Another fundamental possible world-formalism with respect to BDI has been suggested by Rao and Georgeff (1991). The main differences with respect to Cohen and Levesque's theory is summarised into two: a) following Bratman, Rao and Georgeff see the notion of intention as primitive alongside beliefs and desires; b) they employ a branching-time temporal logic, where time is conceived of as a tree whose branches represent different time points, i.e. possible future scenarios. Each possible world can be seen as a time tree, whose branches represent agents' choices about realizing different courses of events. So a time tree is somehow similar to a traditional decision tree. A time point related to a specific world is called a *situation*. Events executed by agents uniquely determine the next time point in a time tree. Temporal formulas are analogous to CTL (computational tree logic). A distinction is made between *state* and *path* formulas. While the former are evaluated with respect to a particular time point in a time tree, the evaluation of the latter concerns a particular path (i.e. sequences of time points) in a time tree. Rao and Georgeff introduce the modal operators

optional and *inevitable* to operate on path formulas. If a path formula *p* is true, at a particular time point *t* in a tree, with respect to at least one path branch off *t*, then *p* is called *optional*. Whereas, if *p* is true of all paths branches off *t*, then *p* is called *inevitable*. Other standard temporal operators, including ◊ (eventually), □ (always), O (next), U (until), operate on both state and path formulas. Rao and Georgeff use the formulas succeeded(e) and failed(e) to represent the success or the failure with respect to the agents' execution of a past event. The formula done(e) represents the fact that an agent either succeeded or failed to execute an event. And the same goes for the formulas succeds(e), fails(e) and does(e), with the difference that they refer to the immediate occurrences of events. Moreover, Rao and Georgeff introduce Bel (p), Goal (p), Intend (p) operators, which stand for the beliefs, goals, and intentions of an agent respectively. In a similar way to Cohen and Levesque, Rao and Georgeff interpret goals as chosen desires. Goals are therefore consistent between them. The semantic of beliefs, goals, and intentions, as usual, is modeled by means of accessibility relations between worlds. So, for example, Bel(p) holds at time point *t* if and only if *p* is true in all the belief-accessible worlds of the agent at time *t*. The same holds for intentions and goals.

Rao and Georgeff (1991) provide many axioms to represent the relationship between beliefs, goals, and desires, attempting to capture Bratman's intuitions about practical reasoning. For instance, the axiom of *belief-goal compatibility* 'Goal (p) → Bel (p)' says that if an agent has a goal to achieve, then they believe that it is possible to achieve it. In other terms, there is at least one path with regard to all agent's belief-accessible worlds in which the proposition *p* is true. But the most interesting thing related to Rao and Georgeff's work is the explicit distinction between different types of intention's commitment with respect to different types of agents. They define three categories of commitment that is *blind, single mind,* and *open mind.* Such commitments are formally stated as follows:

Blind commitment:

Intend (*inevitable* ◊p) → *inevitable* (Intend (*inevitable* ◊ p) U Bel (p))

Single mind commitment:

Intend (*inevitable* ◊p) → *inevitable* (Intend (*inevitable* ◊p) U (Bel (p) ∨ ¬ Bel (*optional* ◊p))

Open mind commitment**:**

Intend (inevtibale ◊p) → *inevitable* (Intend (*inevitable* ◊p) U (Bel (p) ∨ ¬ Goal (optional ◊p)))

Let us explain these commitments. Starting with agents that are blindly committed, we might say that they will maintain their intentions for as long as they believe that they haven't yet fulfilled them. This kind of commitment is clearly too strong and it is called 'fanatical', since agents continue to obstinately pursue their goals until they have achieved them, which is not rational. Sometimes giving up is necessary in order to revise our intentions, for instance when we realize that there is no way to get what we aim at. Thus Rao and Georgeff relax the requirement of blind commitment with the notion of single mind commitment. Agents that are single mind committed continue to maintain their intentions until they believe that such intentions have been fulfilled or it is no longer possible to fulfill them. Finally, also the requirement of single mind commitment can be relaxed by resorting to the concept of open mind commitment. Agents that are open mind committed continue to maintain their intentions simply as long as they believe that such intentions are possible to be realized. It is time to draw some conclusions, from a philosophical point of view, with respect to the logical approaches to the BDI model that we have discussed so far. First of all, we have seen how BDI logics successfully described many requirements of Bratman's theory of intentions, especially in the direction of a clarification of the notion of commitment. Such a commitment is, as we know, what leads Bratman to theorize the notion of intention as a mental state that has a particular motivational role that pushes agents to act. In this sense, BDI logics with their rigorous formal analysis help to bring out and fully justify the relevant role of intentions in practical reasoning. Yet, within BDI logics we can find implicit assumptions about mental attitudes which can lead out to philosophical ambiguities. Let us justify this observation. Cohen and Levesque, as well as Rao and Georgeff, assume the standard notion of mental attitudes as mental states about propositions. So propositions should be viewed as *contents* of mental attitudes. Moreover, they often state that rational agents, in *achieving* or *realizing* propositions, *bring about* actions or events (cf. Cohen & Levesque, 1987; Rao & Georgeff, 1995, 1991). But this sounds strange, since propositions as *contents* of mental attitudes can't be realized or achieved, rather they are said to be true or false depending on their truthmakers, be it conceived of as states of affairs or events. However, much depends on what role propositions are called upon to play. In fact, in terms of possible worlds semantic, propositions can be just seen as sets of possible worlds. In this respect, it could make sense to claim that rational agents bring about events while 'realizing'

propositions. From this perspective, possible worlds represent possible events and we might say that those possible worlds in which propositions are true result to be compatible with or satisfy rational agents' mental attitudes. In any way, in BDI logics there seems to be a tension between two ontological conceptions of propositions, that is: a) propositions as *intensional* entities, that is abstract objects that serve as contents of mental attitudes; b) propositions as *extensional* entities, that is functions from possible worlds' truth-values. In BDI logics the latter sense of proposition is explicitly embraced, while the former meaning remains in the shadows, but nevertheless, conceptually speaking, it is still present. The fact that the notion of content of mental attitudes results somehow neglected within this context, is not a shortcoming of the logical approach to BDI, since it is not supposed to be a philosophical theory of mental attitudes, but rather it is just a formalization inspired by Bratman's work. More generally, we might observe that, with respect to the BDI literature, included Bramtman's philosophy, the notion of content of mental attitudes is just assumed but not grounded. The same is true for the very concept of intentionality, which is, in the best of cases, invoked by a quick reference to Dennet's theory of international stance. Yet, a superficial reading of intentionality or aboutness raises questions as to whether rational agents' goals, desires, and beliefs are about events, propositions, or even states of affairs, as sometimes is stated in BDI; ontologically speaking, this represents a shortcoming with respect to the representation of a good model of mental states. A philosophical analysis of mental states cannot prescind from directly dealing with an explicit discussion of intentionality and its problems. For all these reasons, in the next paragraph, we are going to complement the BDI model appealing to the analysis of intentionality discussed in the 2nd chapter. In doing so, we shall propose an ontology of mental states that, taking inspiration from BDI, introduces needs as another kind of pro-attitudes.

4.3 BDI plus Need

We have seen how intentions play various roles in practical reasoning. The main roles can be summarized with two points, that is: a) intentions entail a special type of commitment with respect to act; b) intentions serve to generate further reasoning, giving means-end coherence within the hierarchical structure of plans. The last point nicely justifies the introduction of a new kind of mental state within the BDI framework, that is the mental state of need. As repeatedly stated in this dissertation, we see mental states of needs as types of *instrumental goals*. As such, needs come into play as part of the means-end reasoning

process. If agent A has a goal x, inevitably, they have to think about *how* to achieve x, in other terms, they need to do something to bring about x. So, we suggest that once the agent has settled a goal, a need arises. Needs are instrumental goals that are *ontologically dependent* on *end goals*, in the sense that if there were not end goals, there would not be instrumental goals. The *end goals* may coincide with *intentions* themselves, if we see intentions *à la* Cohen and Levesque, or can be simply goals *intended* by an agent, if we interpret intentions as different from goals *à la* Rao and Georgeff. A need is just a means to an end, and once the need has been satisfied, its duty, so to speak, comes to an end. Being part of means-end reasoning, we suggest that, along with intentions, needs help to give coherence within the hierarchical structure of plans. In fact, needs, as well as intentions, impose certain constraints on conduct that can be captured outlining the relationship between mental states of needs as instrumental goals and their satisfiers. Let us recall this matter, which has been addressed in the 1st chapter.

We have distinguished a need as such, which is a mental state, from what is needed, which is the satisfier that has the function of satisfying a need. Thus, for instance, if Giovanni needs to take the car to go to Rome, we can distinguish between Giovanni's mental state of need on the one hand, and the event of taking the car (satisfier) on the other. The example highlights that 'taking the car' is a sufficient condition to go to Rome. However, 'taking the car' is not a necessary condition to achieve Giovanni's end goal, which is indeed 'going to Rome'. In fact, Giovanni could decide to go to Rome by car or by train, that is to say, choosing different satisfiers. Now, taking the example 'Laura needs to hold the Green Card to work and live permanently in the U.S.A'. In this case, 'holding the Green card' is the only possible satisfier to reach Laura's end goal, which is 'work and live permanently in the U.S.A'. For one thing, the latter example is similar to the former insofar as both show a means-end framework, in other words, both are examples of instrumental goals. For another thing, while the former example implies only a sufficient condition to the end goal achievement, the latter implies a necessary and sufficient condition. From this follows that there are two kinds of instrumental goals whose structure depends on the relationship between needs and satisfiers, that is: a) instrumental goals that require satisfiers that are sufficient for realizing end goals; b) instrumental goals that require satisfiers that are, besides sufficient, also necessary for realizing end goals. This distinction seems to capture our common-sense distinction between saying 'I need to do x, y or z to obtain w', namely x, y or z 'could be of help', and 'I need to do x to obtain w', the latter conveying a stronger message and an implicature, that is 'I cannot do without it', where this locution expresses

the meanings of words such as ‘necessity’ or ‘indispensable‘ or ‘urgent’. To sum up, we might say that mental states of needs conceived as a kind of instrumental goal constrain the hierarchical structure of plans, setting up either sufficient or necessary and sufficient conditions to goals achievement. But what do we mean by ‘goal’?

Following Cohen & Levesque (1990), we derive the notion of goal from other concepts. In fact, by the term ‘goal’, we mean a class of mental states that includes both *selected* desires and needs, that is a specific desire or a specific need that an agent has selected among a set of desires and a set of needs respectively. Moreover, appealing to the assumptions discussed in the 1st chapter, we distinguish needs from desires, thus selected needs and selected desires represent two disjoint classes of goals. In particular, by saying that both desires and needs are kinds of goals, we endorse Castelfranchi’s view (see Castelfranchi, 1998). Typically, we can have several incompatible desires and needs at the same time. For instance, I may desire to go to the cinema on Sunday and, at the same time, I may desire to go to the theater. Also, I may need to rest this morning and, at the same time, I may need some exercise. In any way, we must decide which desires or needs shall be satisfied at some point. Once the choice has been made, the selected desire or need is said to be *consistent* (Cohen & Levesque, 1987; Rao & Georgeff, 1991), i.e. the choice rules out other possible incompatible desires or needs. In other words, the selected mental state, be it a desire or a need, becomes a goal to pursue. Furthermore, as we shall see, we suggest that while needs can only be interpreted as kinds of instrumental goals, desires can be viewed as both instrumental and end goals.

In addition, we claim that needs are, to use Bratman’s expression, a type of *pro-attitude*, alongside intentions and desires, namely mental attitudes that play a certain motivational role with regard to act. The motivational role inherent to the concept of need can be explained by the fact that, as Castelfranchi has stressed (1998), needs are thought of as negative mental states, that is in terms of deprivation (i.e. If someone needs x, then they lack x). From an instrumentalist point of view, if the need’s satisfier is not reached, then the related need is not satisfied, and the agent’s expectations about the end goal are frustrated. The avoidance of such frustration calls upon agents to take action.

4.4 DOLCE ontology of mental states for PA's services[53]

We are going to adapt our assumptions about agents' mental states, integrating them with the theory of intentionality, while proposing an ontology that employs the categories of DOLCE illustrated in the 3rd chapter. The main purpose is to model different kinds of needs useful to classify PA's services. Before we begin, let us make some clarifications on the approach that we are developing, briefly recalling our theory of intentional objects discussed in the 2nd chapter. First of all, we have analyzed the notion of intentional object in terms of roles, where a role has been defined as a founded and anti-rigid property. With respect to a certain entity, we have suggested that being an intentional object is nothing but playing a role within the reference intentionality (RI) relation, namely the property of thoughts of being about objects. We have said that such a perspective on intentional objects can be applied to those theories that endorse two assumptions, that is a relational view on intentionality and a mind-independent conception of intentional objects. For as we have defined roles, holding these assumptions is necessary, since entities that instantiate the property of 'being intentional object' must be in a RI relation with other entities that instantiate the property of 'being a thought', with the additional constraint that the latter entities cannot be part-of the former entities. Now, between the various theories of intentional objects that we have shown to be compatible with our approach, we choose to inspire the design of the ontology that we are going to introduce on the so-called 'Traditional picture (TP)' on intentionality. This choice is motivated by modeling reasons, given that TP, as we shall see, fits well into the DOLCE framework.

So let us briefly recall the basic theoretical assumptions supported by TP. What characterizes TP is a triadic view on intentionality, where contents are a kind of mediating entities by which mental states can manage to indirectly refer to objects, provided that such objects exist. With respect to TP, we have said that RI corresponds to the complex relation 'mediated intentionality (MI)', which is composed of two simple relations, that is 'directedness (DS)' and 'determination (DT)'. The former relation is what allows contents to identify or pick up objects, provided that such objects exist. The latter relation corresponds to what we called 'mental reference', the fact that mental states refer to objects. Following Haldane (1989), in

[53] This section discusses the main assumptions and results that we presented in Biccheri et al. (2020), in which we have provided a first ontological analysis of both instrumental and absolute needs. However, in this dissertation, the deepening of the themes of needs and intentionality has led us to exclude absolute needs from the investigation, given that these cannot be construed as mental attitudes, unlike instrumental needs. Thus here we shall deal only with the latter kind of needs, besides placing more emphasis on differences and continuities between needs and desires *qua* kinds of goals.

our ontology we will use the terms 'aboutness$_1$' and 'aboutness$_2$' as equivalent to DS and DT respectively. Moreover, we have shown that, concerning TP, not only intentional objects but also *contents* can be interpreted as a kind of *role*. We shall use the expression 'intentional content' to refer to the role played by contents[54].

This being said, with reference to DOLCE-CORE categories, we will interpret intentional contents as *concepts*[55]. Such concepts, as we have already explained in the 3rd chapter, are particulars[56] defined by descriptions accepted by a community of intentional agents. Concepts can classify different kinds of entities, for example, objects as well as events. Concepts classify entities that satisfy all the constraints in the concept definition. Furthermore, the classification relation is associated with a time parameter that identifies a specific interval in which the classified entity satisfies the definition, more formally cf (x,y,t) stands for 'the concept x classifies the entity y at time t'. Given that our ontology is designed to deal with PA's services, and that, ontologically speaking, services can be seen as events (cf. Ferrario & Guarino, 2009), in this dissertation, we will focus only on concepts that classify events. Let us consider an example. To financially support families, in some countries, new parents are automatically entitled to receive a child benefit. Now, we can imagine that PA records in some official documents descriptions about such type of services, defining a concept like 'Providing a child benefit'. Each service provision that satisfies all the constraints in the concept definition, for example, 'Giovanni sends the payment on Lucia's bank account at 5 PM on May 13, 2021', is a particular event that is classified by that concept. Given that PA's services are designed to meet citizens' needs, here's where the study of the intentionality of citizens' mental attitudes comes in. We might imagine, referring to the above-mentioned example, that Lucia is a citizen who needs *a child benefit*. In this case, Lucia's mental state of need will be *about$_1$* the concept 'Receiving a child benefit', and this content will play the role of intentional content of the mental state. Moreover, it is in virtue of such concepts that Lucia's mental state can be *about$_2$* a particular event that satisfies the concept. Such a particular event will play the role of the intentional object of the mental state. Note that for the purposes of modeling the ontology, we have to make a simplifying assumption as regards the knowledge about mental states. That is, we assume that PA is able,

[54] For the various uses of such expression within the literature about intentionality see (Voltolini & Calabi, 2009).

[55] Cf. (Borgo & Masolo, 2009).

[56] Recall that in DOLCE concepts, as well as roles, have been 'reified' to be able to predicate on them using first-order logic. Conceptually speaking, concepts as well as roles are still properties. However, in order to avoid second-order quantification, concepts and roles have been treated as 'first-class citizens' in the ontology.

so to speak, to 'watch inside' citizens' minds. So we are taking a third-person perspective that attributes to citizens some mental state, as well as the related intentional concept and intentional object. Moreover, note that we depart from TP in some respect. We know that, according to TP, contents can be seen as the meanings expressed by singular terms, like for example proper names and definite descriptions. While proper names are rigid designators, that is they refer to the same entity at all times and possible worlds, definite descriptions are not necessarily rigid. For instance, 'the president of the USA' can refer to different entities with regard to different times and possible worlds. It is easy to see that such a definite description is a concept, more specifically, a role. But a proper name *cannot* be a concept because it is a rigid-designator. Since concepts, as well as roles, are anti-rigid, our framework cannot deal with rigid designators. However, this fact does not represent a limitation for our purposes. In fact, in our framework, we need to allow concepts, *qua* intentional contents, to refer to different entities. As we have already said, concepts *classify* different entities, each of which satisfies the way in which concepts are defined. So each agents' mental state can refer to, namely, can be about$_2$ *one event* among a *set* of events classified by a concept. In other words, entities that play the role of intentional object can be 'indeterminate'. By this, we are not suggesting that the entities that count as intentional objects are, from an ontological standpoint, *incomplete objects à la* Meinong. As we know, the DOLCE domain of quantification ranges only over particulars. All we are saying is that concepts are *satisfied* by *any* entity that *meets* the *conditions* established by descriptions that define *concepts*. Thus, the role of intentional object can be played by *any* particular among a set of particulars that satisfy a certain concept. This is a necessary requirement to model the PA's needs-driven services domain since when a citizen needs a service like the provision of a child benefit they don't have in mind a specific provision, any provision goes.[57] It is worth noting that two different concepts can classify the same entity. That is to say, the same entity can be

[57] From a grammatical point of view, a concept like 'a child benefit' can be interpreted as an indefinite description. In the philosophical literature on intentionality, indefinite descriptions are related to indeterminate or non-specific intentional objects. As Crane has stressed "You can want a glass of wine without there needing to be any specific glass of wine which you want. But of course, when you achieve the object of your desire, you will get a specific glass of wine, since there is no such thing as a non-specific glass of wine" (2013, p. 131). In this case, Crane suggests that there are conditions of satisfaction related to the content of desire that characterize the kind of entities that would satisfy it. More specifically, that desire can be satisfied by obtaining any specific entities of a certain kind according to satisfaction conditions. In Crane's words " what it is to have an unspecific object as the object of your desire is for your desire to have a certain nature: that it is the kind of desire that is satisfied by a thing of a certain kind […] It is a desire for an object; what you desire can be unspecific or indeterminate; but it is a desire that can be satisfied by your obtaining any specific object of a certain kind" (2013, p. 133). In our framework the descriptions that define concepts establish conditions of satisfaction for entities that they classify.

'grasped' in different ways, similarly as it happens with contents in TP (e.g. 'the morning star' and 'the evening star' refer to the same entity). For instance, the event 'Giovanni sends the payment on Lucia's bank account at 5 PM on May 13, 2021' can be classified by the concept 'providing a child benefit' or 'paying off a debt to a friend'. Moreover, given that descriptions, and therefore concepts defined by such descriptions, are accepted by a community of intentional agents, concepts may be 'shared' by several agents, in the sense that different agents are supposed to cognitively grasp the same concept referring to the same entity at a certain time[58], analogously as for contents with respect to TP. Lastly, another analogy between TP's contents and DOLCE's concepts is related to the failure of reference in cases of nonexistent objects. According to TP, when a mental state is about a nonexistent object, such mental state does not refer to something but still has content, just like in our framework concepts can exist regardless of classifying a certain entity at a certain time. Take for example the concept 'The King of Italy', which exists even if it doesn't classify any entity at the moment.

Now we are ready to introduce our ontology[59]. First of all, we see needs, desires, goals, beliefs, intentions, etc. as mental states (MS), which are a type of states (ST), which in turn are a type of events (E). We should be careful not to confuse MS with a certain conception of mental states that we can find in the literature about the philosophy of mind, where mental states are distinguished from mental events. While the former are just *properties* instantiated by particulars at a certain time, the latter are *particulars* themselves that have temporal parts and occur at a certain time (cf. Crane, 2001a). So by MS, we mean mental events. Intentional agents are classified as agentive physical objects (APO) that *participate* in MS. Participation (pc) is a ternary relation that represents the main way by means of which objects and events are bound together, so pc(x, y, t) stands for 'the object x participates in event y at time t'. The binary relation 'being present at' is used to represent the existence of particulars at a certain time, therefore pre(x,t) is read as 'x is present at time t'. Agents' mental states are assumed to be private events, that is to say, with respect to a mental state y the same agent x participates in y for all time intervals in which y is present. In other terms, mental states cannot exist without an agent entertaining them. Also, the same mental state cannot be

[58] For instance, different agents could share the concept of 'The Italian Prime Minister during 2020', and in doing so would refer to the same entity, that is Giuseppe Conte.

[59] We tested the consistency of our ontology as well as its provable consequences. In what follows, we present an excerpt of the axioms. For more details see https://github.com/diporello/DOLCE-mental_states-needs/blob/master/dolce_needs.p

entertained by different agents. The following axioms formally capture the assumptions mentioned above:

A1 $MS(x) \rightarrow ST(x)$

A2 $MS(x) \rightarrow (\exists y\, t.(APO(y) \wedge pc\,(y, x, t)))$

A3 $MS(x) \wedge APO(x_1) \wedge APO(x_2) \wedge pc(x_1, x, t) \wedge pc(x_2, x, t') \rightarrow x_1 = x_2$

A1 claims that mental states are types of states, therefore types of events. A2 and A3 state that agents participate in mental states and that such mental states are private to agents, respectively. Now we can switch to formally constrain the meaning of reference intentionality (RI) that is split into aboutness$_1$ and aboutness$_2$, as well as the notions of intentional content and intentional object:

A4 $about_1\,(x, y, t) \rightarrow MS(x) \wedge C(y) \wedge T(t)$

A5 $MS\,(x) \rightarrow \exists y\, t.(about_1\,(x, y, t))$

A6 $about_1\,(x, y, t) \wedge about_1\,(x, y', t') \rightarrow y = y'$

D1 $about_2\,(x, z, t) \leftrightarrow (MS(x) \wedge T(t) \wedge \exists y.(about_1\,(x, y, t) \wedge cf\,(y, z, t)))$

D2 $intCont\,(y,t) \leftrightarrow \exists x.\ about_1(x, y, t)$

D3 $intObj\,(z,t) \leftrightarrow \exists xy.(about_1\,(x, y, t) \wedge about_2\,(x, z, t))$

Axioms 4-5-6 capture the relation between mental states and concepts (C). A4 represents about$_1$ as a ternary relation that involves mental states, concepts, and time intervals (T). A5 says that every mental state must be about$_1$ a concept, while A6 adds the further constraint that every mental state is directed *exactly* at one concept. This means that if two mental states are directed to different concepts, then such mental states are different. D1 makes explicit that about$_2$ is a ternary relation between mental states, particulars, and times intervals, whereby mental states succeed in referring to particulars by means of concepts that classify (cf) such particulars. Typically, concepts classify more than one particular, so the entity to

which a mental state refers is one among the set of classified particulars. Yet, if a concept does not classify anything at a certain time, then the reference is empty. D2 and D3 define intentional content (intCont) and intentional object (intObj) as roles played by concepts and any kind of particular respectively.

Once defined the theoretical framework about intentionality, we can move on to take into consideration different classes of mental states. Note that, since we are primarily interested in making explicit the senses of 'instrumental need' that have been discussed in this dissertation, we will investigate only those mental states that are useful to this aim. More specifically, as it is customary among modern needs' theorists, we shall clarify the ontological nature of needs contrasting them to desires (see chapter one). So, in the first place, we will focus on two disjoint subtypes of mental states, that is, desires and needs, conceiving them as primitive concepts[60]. Then, we will derive from them the concept of 'goal state'. This being said, we will use DS(x) and NS(x) to mean that 'x is a state of desire' and 'x is a state of need' respectively. Moreover, we will introduce abbreviations *à la* BDI, like for example $\text{des}_0(i, y, t)$ as a shortcut to say that 'there exists a desire state x to which an agent i participates and such state is about_1 a concept y at a certain time t'. The same goes for the abbreviation $\text{need}_0(i, y, t)$, which means 'there exists a need state x to which an agent i participates and such state is about_1 a concept y at a certain time t'[61]. More formally:

D4 $\text{des}_0(i, y, t) \leftrightarrow \exists x\,(\text{DS}(x) \wedge \text{pc}\,(i, x, t) \wedge \text{about}_1\,(x, y, t))$

D5 $\text{need}_0(i, y, t) \leftrightarrow \exists x\,(\text{NS}(x) \wedge \text{pc}\,(i, x, t) \wedge \text{about}_1\,(x, y, t))$

Now we define mental states of *goals* as those needs or desires that are *consistent,* that is, the class of goals includes selected desires, as well as selected needs (see sections 4.1 and 4.3)[62]. We represent goals by means of the abbreviation goal(i, y, t) that stands for 'the agent

[60] By the locution 'primitive concept' we are referring here to those concepts that, with respect to a specific data model, cannot be defined in terms of other concepts. Viceversa, the locution 'derived concept' stands for those concepts that are defined resorting to other concepts (see West, 2011). In this respect, desires and needs are meant to be primitive concepts, while goals are derived concepts.

[61] We use the abbreviations 'des_0' and 'need_0' as a starting point to define selected desires and needs, i.e. desires and needs *qua* goals. Such kinds of goals will be discussed shortly.

[62] As we said, desires and needs are said to be consistent in as much as they have been selected by an agent among a set of alternative desires and needs respectively, thereby excluding the possibility to satisfy, at the same time, other desires or needs whose satisfaction is incompatible with the selected desires or needs. These latter therefore become goals to pursue. Yet, from the simple fact that an agent has a goal, we cannot assume that they will accomplish such a goal. As Cohen and Levesque (1990) and Rao and Georgeff (1991) have remarked, typically agents can drop or revise their goals according to different types of commitments. To define the concept of 'commitment', it is necessary to take into account the relations between different types of mental states, first of all, the relation that holds between intentions and beliefs, as well as the thorny issue related to

i has goal *y* at *t* iff *i* desires or needs *y* at *t* and *i* has no desires or needs inconsistent with *y*', formally:

D6 $\text{goal}(i, y, t) \leftrightarrow ((\text{des}_0(i, y, t) \vee \text{need}_0(i, y, t)) \wedge \forall w.(w \neq y \wedge (\text{des}_0(i, w, t) \vee \text{need}_0(i, w, t)) \rightarrow \neg\exists z\ (\text{cf}\ (y, z, t) \wedge \text{cf}(w, z, t)))$

In addition, goals are divided into *instrumental goals* and *end goals* and represented using, respectively, the abbreviations igoal(*x, y, t*) and egoal(*x, y, t*). Defining such goals requires the introduction of the notion of satisfier[63], which is the *event* that satisfies the concept related to a goal state[64]. The abbreviation for the satisfier is sat(*e, y, t*) that stands for 'an event *e* is present at a certain time *t* and a concept *y* classifies *e* at *t*'. We assume that time intervals are strictly ordered by '$\prec$'. Now, we can think of instrumental goals as mental states that, as long as they are satisfied, bring about an event that satisfies a *subsequent* goal, that is an end goal. The latter, as opposed to instrumental goals, does not require to satisfy other goals, namely, end goals are pursued *per se.* Satisfiers, instrumental goals, and end goals are formally captured as follows:

D7 $\text{sat}(e, y, t) \leftrightarrow \text{pre}(\text{e}, t) \wedge \text{cf}\ (y, e, t)$

D8 $\text{igoal}(x, y, t) \leftrightarrow (\text{goal}\ (x, y, t) \wedge \exists y't'.(\text{goal}(x, y', t') \wedge t \prec t' \wedge (\exists \text{e.sat}\ (e, y, t) \rightarrow \exists e'.\ \text{sat}\ (e', y', t'))))$

D9 $\text{egoal}(x, y, t) \leftrightarrow \text{goal}(x, y, t) \wedge \neg\text{igoal}(x, y, t)$

Finally, we are able to refine our notions of 'need' and 'desire' as goal states. We introduce need_1 as instrumental goals whose satisfiers, if realized, create *sufficient* conditions to achieve the end goal and need_2 as instrumental goals whose satisfiers, if realized, create *necessary* and *sufficient* conditions to achieve an end goal. For what concerns desires, similarly to need_1, we use the abbreviation des_1 to refer to desires *qua* instrumental goals whose satisfiers, if realized, create *sufficient* conditions to achieve the end goal and des_2 to represent those desires that are conceived of as end goals, i.e. goals that are pursued *per se.* Such types of needs and desires are defined as follows:

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the side effects of intentions (i.e. If the agent X intends A, and A implies B, this does not necessarily mean that X intends B). However, we will not deal with these problems, since here we are simply interested to provide a first characherization of the notion of instrumental need in a means-end perspective.

[63] See chapthers one and two (section 2.5).

[64] DOLCE assumes a possibilist view. Adopting the QS5 modal axioms, the domain of quantification ranges over possible entities, regardless of their actual existence. Hence the domain includes possible events.

D10 $need_1(x, y, t) \leftrightarrow igoal(x, y, t)$

D11 $need_2(x, y, t) \leftrightarrow (igoal\ (x, y, t) \wedge \exists y't'\ .(goal\ (x, y', t') \wedge t \prec t' \wedge (\exists e.sat\ (e, y, t) \leftrightarrow \exists e'\ .sat(e', y', t'))))$

D12 $des_1(x, y, t) \leftrightarrow igoal(x, y, t)$

D13 $des_2\ (x, y, t) \rightarrow egoal(x, y, t) \wedge des_0(x, y, t)$

In conclusion, we have distinguished mental states of need NS(x) from mental states of desires DS(x), whose content and agent are represented by D5 and D4 respectively. Then, we have represented mental states of goals as selected needs or selected desires (cf. D6). Goals have been further subdivided into igoals (cf. D8) and egoals (cf. D9). Finally, we have defined two different kinds of mental states of need *qua* instrumental goals, that is, $need_1$ and $need_2$ (cf. D10 and D11), and two kinds of mental states of desire, namely des_1 that aims to capture the notion of desire as an instrumental goal (cf. D12) and des_2, which introduces the view of desires as end goals (cf. D13).

This being said, ontologically speaking, one of the main differences between needs and desires *qua* goals is that while needs can be only instrumental goals, desires can be both instrumental and *end goals.* To see why this is so, recall that the verb 'need' refers to a mental state, more specifically an intentional mental state, only in its *instrumental sense* (see 2nd chapter, section 2.5). On the contrary, every time that a need is conceived of as an end goal *per se,* we are dealing with an interpretation of the verb 'need' taken under its absolute meaning. But, as discussed in the 1st chapter, far from being goals proper (i.e. mental representations), absolute needs are just pseudo-goals (i.e. biological functions). On the other hand, this argument does not apply to selected desires, given that these remain goals proper both as instrumental goals and as end goals. So 'John desires to become the best soccer player in the world' and 'John desires to come back home to pay a visit to his mother', are two examples that involve desires *qua* goals proper, the only difference is that while the former is conceived of as a goal *per se*, the latter is conceived of as an instrumental goal to realize in order to achieve an end goal. We would like to make a final consideration about desires and needs *qua* goals.

On the one hand, as we discussed (see chapter one), desires and needs are clearly two different kinds of mental states. For instance, as Castelfranchi (1998) has outlined, differently from needs, desires are more 'positive' in the sense that they imply pleasurable

experiences, while needs are usually related to negative perceptions, feelings, or emotions. Furthermore, needs *qua* instrumental goals are 'negatively conceptualized', that is agents see needs in terms of negative perspective with respect to the achievement of the end goal. In fact, when "we say that 'x needs y/q for p', we say that if x does not have y/q, x will not realize p. And we usually also presuppose that currently x has not y/q" (Castelfranchi, 1998, p. 56). On the other hand, needs and desires *qua* goals have in common a certain instrumental role played with respect to means-end reasoning. For instance, Luigi may desire to meet Carla to talk to her. In the example, Luigi's mental state of desire is an instrumental goal whose satisfier (i.e. 'meeting Carla') represents a sufficient condition to achieve Luigi's end goal, whose satisfier is 'talking to Carla'. In any way 'meeting Carla' is not a necessary condition to achieve the end goal, in fact, Luigi may just call Carla. So, according to our analysis, Luigi's instrumental goal can be classified as des_1. The same holds for those needs that we have called $need_1$. For example, Luigi may need help solving math problems. In this case, Luigi's mental state of need is an instrumental goal whose satisfier (i.e. 'getting help') represents a sufficient condition to achieve Luigi's end goal, whose satisfier is 'solving math problems'. Once again, the satisfier 'getting help' is not a necessary condition, since Luigi may just need to try harder. In both these examples, desires and needs involve a certain 'instrumentality' that seems to result from a choice. Such 'instrumentality' can be expressed by the formula 'I need/desire to do x, y or z to obtain w', namely x, y or z 'could serve to achieve w'. Yet, there is another sense of 'instrumentality' that rules out possible choices between different alternatives, and this is precisely the sense involved in those instrumental goals that require satisfiers that are, besides sufficient, also necessary for realizing end goals, that is to say, the sense expressed by the locution 'I cannot do without it'. This expression conveys a strong message such as 'it is necessary' or 'it is indispensable' or 'it is urgent', a message whose meaning is more suited for capturing our idea of what needs are really about. We suggest that the role of an instrumental goal whose satisfiers, if realized, create *necessary* and *sufficient* conditions to achieve an end goal can be played only by needs, more specifically by those needs that we have called '$need_2$' (e.g. John needs to take medicines to maintain his blood pressure).

5. Classifying needs and individuating related services

5.1 PA's services and citizens' needs

In this chapter, we will contextualize the discussed ontology with respect to the PA's services domain, showing how our theory of needs could be useful in the design phase to the individuation of citizens' needs and related services. Finally, we will provide an OWL (Web Ontology Language) version of the concepts that have been formalized in section 4.4, using the ontology editor Protégé. But first of all, let us briefly explain the notion of service that we have decided to adopt. The term 'service' is notoriously ambiguous, given that it can be used in different senses. As Ferrario and Guarino have outlined:

> Sometimes the term "service" is used to indicate an action (actually performed by somebody), or a generic type of action (including in this category data manipulation procedures such as those typically described as Web services) or perhaps the capability to perform some action; other times it refers to the result of such action, which is typically a change affecting an object or a person, or just the (subjective) value, or utility of such change; moreover, in certain settings (like Public Administrations) the term denotes an organization acting (or in charge of acting) in a certain way in the interest of somebody. (Ferrario & Guarino, 2009, p. 154).

In any way, it is possible to comply with a mesoscopic level of ontological investigation that is wide enough to account for different semantic nuances of the concept of service. In this respect, Ferrario and Guarino (2009) propose an ontological analysis, based on DOLCE, that starts with the distinction between *services* and *goods*, assuming that these entities are included in different categories. If on the one hand, goods are both *transactable* and *transferable*, services are only *transactable*. From an ontological standpoint, the reason why services are not transferable lays in the fact that they are *events*, as opposed to goods, which are instead *objects*. This is evident from the fact that when you pay for goods, for instance, a laptop, you become the *owner* of such an object. The ownership implies that you have some kind of control over the behavior of the object (e.g. you may decide to use the laptop for work or, let's say, lend it to a friend). On the contrary, when you pay for a service such as 'having a haircut from your trusted hairstylist' you do not become the *owner* of such service, this being an event that has temporal parts. In other terms, you can't control the

temporal behavior of an event, since it "is already determined, and changing it would result in a different event. So events are not transferable simply because they are not 'ownable'. Since services are events, they are not transferable as well" (Ferrario & Guarino, 2009, p. 158). Moreover, to characterize services it is essential to maintain a *commitment* between someone that guarantees the performance of services (e.g. the service producer) in somebody's interest (i.e. the customer), who agrees and believes they can benefit from the service in a certain way and at certain costs. It is worth noting that, in the European context many PA's services, as opposed to the private sector, are free of charge (e.g. health and education services), especially with respect to the lower-income section of the population. Therefore, within the PA's domain, it is preferable to talk about citizens with certain rights and needs when referring to the beneficiaries of the services, rather than mere customers. Depending on the type of service provided by the PA, we have different *triggering* events related to service activation. There are two main types of services, that is *reactive* services and *proactive* services. In the case of reactive services, citizens take the initiative to request the PA to provide some services according to their needs. Services are provided as long as citizens' profiles respect certain specific requirements (e.g. in Italy you must be in possession of the European Health Insurance Card to access health services). If a citizen meets the specific requirements for the activation of the service, then the PA will proceed with the service activation. In any way, the triggering event for the service activation is represented by the citizen's request. In this sense, we can say that services are 'reactive', that is they show a response to inputs originated by citizens' requests. On the other hand, with respect to proactive services, the PA directly attributes some needs to citizens, by proposing beforehand services to satisfy such needs. Even in this case, PA has to previously check that citizens' profiles respect certain specific requirements for the service activation. However, here the triggering element is represented by the so-called 'life event' which indicates that citizens may be in a certain state of need. Life events are kinds of events that are particularly significant with respect to people's life. Below is a list[65] of most common life events:

- Having a child
- Becoming a (social) caretaker
- Starting education

[65] For more details about life events see the Core Public Service Vocabulary Application Profile (CPSV-AP) at the following link : https://ec.europa.eu/isa2/solutions/core-public-service-vocabulary-application-profile-cpsv-ap_en

- Looking for a new job
- Losing/quitting a job
- Looking for a place to live
- Changing relationship status
- Driving a vehicle
- Travelling abroad
- Moving to/from the country
- Going into military service
- Facing an emergency / health problem
- Facing a crime
- Retirement
- Death of a relative

Thus, for example, citizens that are going to retire need to receive a pension to financially support themselves in their old age. Based on the information stored in the data PA's database system, it should be possible to establish when the event 'retirement' will occur with regard to citizens, and therefore provide the service 'pension payment' to satisfy their needs. In a way, we might say that, following its own initiative, the PA attempts to 'predict' citizens' states of needs and to satisfy them by providing services. This would be done without an explicit citizen's request, but presuming that the provided services are in line with the citizen's will to satisfy their needs. In this respect, services are called 'proactive', given that they are provided without waiting for citizens' service request, but rather they reach out in advance to citizens every time that a state of need arises[66]. Generally, citizens know better their own needs than the PA, while the PA knows better than citizens which means (i.e. services) are available to satisfy their needs. This is due to the fact that citizens have a first-person knowledge about their own mental states of need, while the PA has to identify citizens' states of needs through a third-person perspective and according to its resources in meeting such needs. However, this may not always be the case. For instance, citizens that are cognitively impaired or unaccompanied minors could be not aware of their own needs. On the other hand, there are well-known kinds of needs which the PA is aware of (e.g. special education needs related to a physical or mental disability, transportations needs and food needs for elderly people, etc.). Moreover, it is necessary to keep track of people's emerging

[66] For a detailed discussion of proactive services see (Erlenheim, 2019).

needs. With the transformation of economic and political processes, and the emergence of new segments in the social realms, people's needs are subjected to growth and change. Nowadays, for instance, it has been argued (Meulenbroek et al., 2019) that there are relevant differences between the generations of baby boomers, generation X, and millennials with respect to workplace needs and related aspects (e.g. the need for professional growth, the need for coaching, the need for leisure-work balance). In any way, in order to provide effective and efficient services, the PA must take into account citizens' first-person knowledge about their own needs already in the service-design phase. This is particularly relevant in the case of proactive services, which aim to *personalize* services according to citizens' needs. In this respect, and more generally, through proactive services, PA attempts to identify citizens' states of need by focusing on specific life events. The attention paid to citizens' first-person perspective in the context of public services fully justifies the cognitive approach to needs presented in this dissertation. But let us explain in which way our analysis of needs can be useful for the design of public services, in particular for proactive services.

PA's services offering can be seen as an institutional process regulated by law and aimed at meeting citizens' needs. The service lifecycle can be summed up in three main phases, that is the designing phase, the execution phase, and the ex-post evaluation phase. In the first phase, the PA has to attribute needs to citizens and associate them with specific services that can best address such needs. Secondly, the PA provides particular services to specific citizens who meet the legal requirements for the activation of services. Finally, the PA checks if the executed services have actually satisfied citizens' needs by means of customer satisfaction analysis. Now, recalling the formalized ontology presented in section 4.4, our analysis can be helpful to guide the designing phase in terms of the identification of citizens' states of need and their satisfiers.

In the following, we will present different notions that can be expressed by the term 'need' and will characterize them through our ontology. To begin with, imagine that John has been injured as the result of a car accident. Referring to the mentioned list of life events, the PA will interpret his situation reporting that he is facing a health problem. The life event allegedly puts John in several mental states of need NS(x). Each mental state of need in which John participates, as well as the intentional contents (i.e. concepts) of such mental states, are represented by the relational term $need_0$. At this point, the PA reasonably assumes that, among John's mental states, there will be an end goal (egoal) such as 'recovering fast from the injury' and consequently attributes to John the need for rehabilitation services. Such a need represents an *instrumental goal* (igoal) with respect to John's *end goal* (egoal).

Depending on John's injury, there will be different kinds of rehabilitation services, for example, rehabilitation hospital care or nursing home care. Now, suppose that the content of John's igoal can be satisfied by providing one of the two services indifferently. Since John's igoal might be met by either rehabilitation hospital care service or nursing home care service, such igoal can be classified as a $need_1$, that is to say, the igoal represents a sufficient, but not necessary, condition to achieve the egoal. To take another example, suppose that John is going to retire. Retirement is another case of life event. In this eventuality, the PA knows that the life event will generate an egoal for John like 'being able to financially support himself in his old age' and accordingly attributes to John the need to receive a pension. Such a need is still an igoal with respect to John's egoal; however, it is a different type of igoal when compared to that of the previous example. In fact, this time the PA assumes that, given its means, 'providing a monthly income to John' is the only service capable of satisfying the content of John's egoal. Given that such igoal represents a necessary and sufficient condition to achieve the egoal, the igoal in question can be represented by the relational term $need_2$.

As we can see, our ontology aims to provide a starting point that allows service designers to link needs to services by adopting a means-end reasoning perspective, focusing on citizens' mental states. In doing so, different senses of the term 'need' are distinguished and their relation with services is made explicit. As far as we know, few ontological proposals (De Kinderen et al., 2013; Dsouza, 2015; Gajderowicz et al., 2018) trying to represent needs-driven services have been presented so far. Such proposals, although with different aims, attempt to model the whole service's lifecycle and try to connect needs to services, assuming already available theories that provide very specific classification systems of needs. For example, Dsouza (2015) has developed the FHN (Fundamental Human Needs) ontology by exploiting the categories about needs theorized by Max Neef (1992), while Gajderowicz (2018) has proposed the e^3service ontology based on Maslow's (1943) hierarchy of needs. On the contrary, our ontology is focused on a mesoscopic level of analyses of needs and, instead of taking the concept of need as given, provides a foundational analysis of the ontological notion of instrumental need. Our categories of needs turn out to be more inclusive than the categories employed by the abovementioned works. In this respect, our analysis offers high-level classes of needs that can be specialized by the service designer following the distinction between $need_1$ and $need_2$. Besides needs, the service designer can account for citizens' mental states of desire about services (e.g. demands for service improvement in quality and cost), thanks to the definitions of des_1 and $desire_2$ given in

section 4.4. In the next paragraph we are going to present an OWL version of our ontology modelled using the Protégé tool.

5.2 An ontology for representing needs-driven services in Protégé-OWL

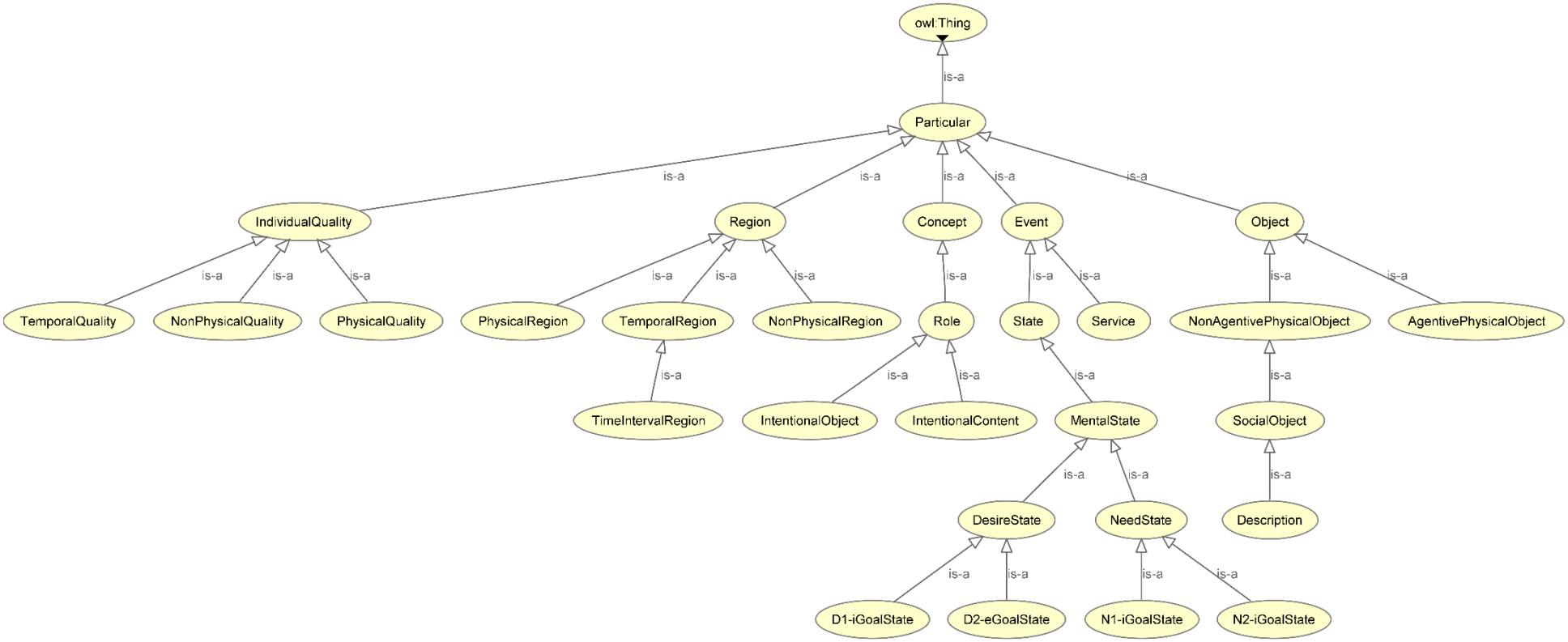
Among the software tools that are used to create, modify, and visualize ontologies, the most successful is Protégé, so as to become a standard to share and manage information within the Semantic Web community. The software has been developed by Stanford University, is based on Java, is extensible, and has a lot of plugins that help to build ontologies. A very useful plugin is the so-called 'reasoner' that allows to check ontology inconsistencies and to automatically generate new inferences (e.g. inferred relationships between classes that are not explicitly declared). Protégé supports the OWL (Ontology Web Language) ontology, whose latest version is OWL2. Moreover, ontologies can be exported in many formats (e.g. XML, RDF, RDF(S)) and it is possible to use SPARQL (Protocol and RDF Query Language) to express queries (similarly to SQL queries in relational databases). Within Protégé, the main components of OWL ontologies are three, that is individuals (aka objects), properties, and classes. Individuals are particular entities that represent instances of classes, for example, Bill Gates, Mick Jagger, Barack Obama, etc. are instances of the class 'person'. In modeling a certain domain of interest, we make statements in OWL language that are about individuals (this holds even when the ontology has not yet been populated, i.e. individuals do not appear within the ontology). Properties are binary relations that link two individuals, for instance, the property 'has a father' might relate Marco to Alessandro. Such properties are called 'Object properties'[67] and can be of different types:

- **Inverse property**: each binary property P can have its inverse Q (e.g. the inverse property of 'has a father' is 'is the father of').
- **Functional property**: for each individual *a*, there is at most one individual *b* that is related to *a* by means of the property P (e.g. 'has a father' is functional, i.e. for any given person, biologically speaking, there is at most one father).

[67] Other types of properties are data properties, which link individuals to data values, and annotation properties that are used to make relevant comments or notes about entities. It is worth noting that the terms 'property' and 'relation' are synonyms in Protégé. Thus hereafter we will use such terms interchangeably. Finally, note that properties in Protégé are equivalent to 'roles' in descriptions logics and 'relations' in UML. See (Horridge et al., 2007).

- **Transitive property**: if a property P is transitive, then from the fact P relates an individual *a* to an individual *b* and *b* to an individual *c*, we can infer that also *a* is related to *c* by means of P (e.g. the property 'is higher than').
- **Symmetric property**: if a property P is symmetric, then from the fact P relates an individual *a* to an individual *b*, we can infer that also *b* is related to *a* by means of P (e.g. equivalence relation).
- **Asymmetric property**: If a property P is asymmetric, then from the fact P relates an individual *a* to an individual *b*, we cannot infer that *b* is related to *a* by means of P (e.g. the property 'is the son of').
- **Reflexive property**: If a property P is reflexive, then P relates an individual *a* to itself (e.g. the property 'being a subset of').
- **Irreflexive property**: If a property P is irreflexive, then P cannot relate an individual *a* to itself (e.g. the property 'is the father of').

Finally, properties can have a specific *domain* and *range,* for instance, the property 'has a father' will have the class 'father' as domain and the class 'son' as range, linking individuals that belong to the former class to individuals that belong to the latter class. Classes are well-defined sets of individuals and can be structured into a taxonomy by way of superclass/subclass relationships. Subclasses are 'specialized' or 'subsumed by' superclasses (e.g. the class 'rose' is specialized by the class 'flower'). Classes are the main element of an OWL ontology. In Protégé the class that contains all individuals is called 'thing', therefore every class is a subclass of 'thing'. This being said, we are ready to introduce our OWL ontology, whose main classes are represented by the taxonomy below.


owl:Thing
is-a
Particular
is-a
is-a
is-a
is-a
is-a
IndividualQuality
Region
Concept
Event
Object
is-a
is-a
is-a
is-a
is-a
is-a
is-a
is-a
is-a
is-a
TemporalQuality
NonPhysicalQuality
PhysicalQuality
PhysicalRegion
TemporalRegion
NonPhysicalRegion
Role
State
Service
NonAgentivePhysicalObject
AgentivePhysicalObject
is-a
is-a
is-a
is-a
is-a
is-a
is-a
TimeIntervalRegion
IntentionalObject
IntentionalContent
MentalState
SocialObject
is-a
is-a
is-a
is-a
DesireState
NeedState
Description
is-a
is-a
is-a
is-a
D1-iGoalState
D2-eGoalState
N1-iGoalState
N2-iGoalState

The OWL ontology is composed of various classes and relations that correspond to DOLCE categories, many of which we have already discussed at length in the 3rd and 4th chapters. A synthetic description of the main classes is given in the following tab[68].

Tab.1 Classes

ClASS	DESCRIPTION
Particular	All individuals that exist in time.
Concept	Subclass of Particular. Concepts are created and accepted by a community of intentional agents and defined by descriptions encoded in linguistic expressions. With respect to the PA's service domain, 'providing a child benefit' can be seen as a concept whose description is recorded in the PA's official documents. Concepts can classify different kinds of particulars (e.g. objects as well as events).
Role	Subclass of Concept. Roles are founded (i.e. they are thought of in terms of relation to other entities) and anti-rigid (i.e. they show a dynamic temporal relation with respect to entities by which they are played). Within the PA's services domain, examples are 'citizen', 'service provider', 'service producer', etc.
IntentionalContent	Subclass of Role. Intentional contents are a kind of mediating entities by which mental states can manage to indirectly refer to objects, provided that such objects exist. As an example, within the PA's services domain, mental states of need are attributed to citizens together with the intentional content of such states. From the PA's perspective, citizens' intentional contents coincide with concepts that express services.

[68] The ontology is available at https://github.com/Lbiccheri24/NDS-needs-driven-services-ontology-/blob/main/NDS.owl

ClASS	DESCRIPTION
IntentionalObject	Subclass of Role. The role of intentional object can be played by any particular that satisfies a certain concept. Particulars that satisfy concepts are those objects which mental states are about. Within the PA's service domain, a single service provision, classifed by the related concept, counts as a particular that plays the role of intentional object with respect to citizens' mental states of need.
Event	Subclass of Particular. Events are 'partially present', that is at any given time of their existence, some of their proper temporal parts might be not present since such parts were present in the past or will be present in the future. Events are said to 'happen in time' (e.g. a symphony, a football match, a university lecture, etc.).
Service	Subclass of Event. Services (e.g. providing a child benefit, releasing a license, etc.) represent the satisfiers of citizens' mental states of need.
State	Subclass of Event. 'Maria's waiting for a call' is an example of state. States are homeomeric (i.e. all their temporal parts are described by the very same expression used to refer to the whole event) and cumulative (i.e the mereological sum of two instances of the same event-type maintains the same event-type).
MentalState	Subclass of State (e.g. beliefs, desires, needs, intentions, hopes, goals, etc.)
DesireState	Subclass of MentalState (e.g. John's desire to win the election)
NeedState	Subclass of MentalState (e.g. John's need to receive some additional income)
D1-iGoalState	Subclass of DesireState. D1-iGoals states are desires that have been selected by an agent to be pursued (i.e. goals). More specifically, they represent desires *qua* instrumental goals whose satisfiers, if realized, create *sufficient* conditions to achieve the related end goal.

ClASS	DESCRIPTION
D2-iGoalState	Subclass of DesireState. D2-iGoals states are desires that have been selected by an agent to be pursued (i.e. goals). More specifically, they represent desires that are conceived of as end goals, i.e. goals that are pursued *per se*.
N1-iGoalState	Subclass of NeedState. N1-iGoal states are needs that have been selected by an agent to be pursued (i.e. goals). More specifically, they represent those needs *qua* instrumental goals whose satisfiers, if realized, create *sufficient* conditions to achieve the end goal.
N2-iGoalState	Subclass of NeedState. N2-iGoal states are needs that have been selected by an agent to be pursued (i.e goals). More specifically, they represent those needs *qua* instrumental goals whose satisfiers, if realized, create *necessary* and *sufficient* conditions to achieve an end goal.
IndividualQuality	Individual qualities are a subclass of particulars that we can perceive or measure (e.g. color, height, temperature, etc). Individual qualities characterize specific particulars (i.e. two different particulars cannot have the same quality). Each quality kind is associated with one or more quality spaces. Individual qualities have locations in quality spaces, that is they are located in a certain point of such spaces at a certain time (e.g. the shade of red of a particular rose is located at a point x at time t in the color space). Within the PA's service domain, individual qualities are useful to characterize different types of services and agents who take part in the service
PhysicalQuality	Subclass of IndividualQuality (e.g. being space-located, weight, shape, etc.)
NonPhysicalQuality	Subclass of IndividualQuality (e.g. the value of a building).
TemporalQuality	Subclass of IndividualQuality (e.g. the duration of services).
Object	Subclass of Particular. Objects are said to be 'wholly present', that is all their proper parts are present at any time of their existence (e.g. chairs, trees, persons, cars, etc.)

ClASS	DESCRIPTION
NonAgentivePhysicalObject	Subclass of Object (e.g. a desk, a house, a vehicle, etc.)
SocialObject	Subclass of NonAgentivePhysicalObject (e.g. laws, agreements, certificates, etc.)
Description	Subclass of SocialObject. Descriptions are created, starting with their first encoding in a public language, by communities of intentional agents. Within the domain of PA's services, public policies can be seen as descriptions that define concepts such as 'health services', 'transport service', etc.
AgentivePhysicalObject	Subclass of Object (e.g. a human person)
Region	Subclass of Particular. Regions represent the location of individual qualities that inhere to particulars within a quality space at a certain time. Similar to concepts, regions are created by a community of intentional agents (e.g. the particular 'x is high 2m at time t' means that there is a quality y that inhere to x such that y is of the quality kind 'height' and y is located in the 2m region within the height quality space at time t).
PhysicalRegion	Subclass of Region (e.g. the Euclidean space)
NonPhysicalRegion	Subclass of Region (e.g. 20 Euro value)
TemporalRegion	Subclass of Region (e.g. a date such as '14th January 2021')
TimeIntervalRegion	Subclass of TemporalRegion (e. g. one second, minute, hour, day, etc.)

With regards to the relations involved in our ontology, we must emphasize that, due to limitations of the expressivity of OWL language, it is possible to express properties only in the form of binary relations. So to represent n-ary relations (i.e. relations among more than two arguments) that are present within our ontology, following the standard method used in

the semantic web community[69], we have had to reify some properties making them 'first-class citizens'. So for each n-ary relation, we have created a correspondent class and *n* new properties meant to represent such relations. For example, take the ternary relation 'participation', which is the main relation between objects and events. Formally, we can express this relation as PC (x,y,t), which is read as 'object x participates in event y at time t'. Participation involves three arguments (i.e. object, event, time interval)[70]. Such a relation has been reified turning it into a class called 'Participation' and for each argument of the relation, we have created a correspondent object property, that is 'pc_arg1_object', 'pc_arg2_event', and 'pc_arg3_time'. Each object property has as domain the class 'Participation' and has as range a specific class that includes one of the three arguments involved in the relation (e.g. the object property 'pc_arg1_object' has as domain the class 'Participation' and has as range the class 'Object'). The same has been done for the other n-ary relations. Reified relations and their object properties are reported in tab 2. Other object properties present in our ontology are reported in tab 3.

Tab. 2 Reified relations

ClASS	DESCRIPTION
ReifiedRelation	Properties that have been reified.

[69] https://www.w3.org/TR/swbp-n-aryRelations/

[70] Note that all the reified relations present in our ontology are ternary relations, that is they involve three arguments. Hence, we decided to use the abbreviations 'arg1', 'arg2', and 'arg3' so as to have a standard way to refer to the arguments places of a relation (e.g. for each argument of the ternary relation 'Participation (pc)', we have three object properties, that is 'pc_arg1_object', 'pc_arg2_event' and 'pc_arg3_time'. In the light of the above, 'arg1' means that 'object' is the first argument of the relation, 'arg2' means that 'event' is the second argument of the relation, and 'arg3' means that 'time interval' is the third argument of the relation. The same criterion has been applied to all the reified relations).

CLASS	DESCRIPTION
Participation	Subclass of ReifiedRelation. Participation is the main relation between objects and events and represents the fact that the 'object x participates in event y at time t'. Instances of the class 'Participation' are linked to instances of the classes 'Object', 'Event', and 'TimeInterval' via the functional object properties 'pc_arg1_object', 'pc_arg2_event' and 'pc_arg3_time' respectively.
Classification	Subclass of ReifiedRelation. Classification is the relation between concepts and other particulars. Concepts classify particulars that satisfy all the constraints in the concept definition. Classification represents the fact that the 'concept x classifies particular y at time t'. Instances of the class 'Classification' are linked to instances of the classes 'Concept', 'Particular', and 'TimeInterval' via the functional object properties 'cf_arg1_concept', 'cf_arg2_particular' and 'cf_arg3_time' respectively.
Location	Subclass of ReifiedRelation. Location is the relation between individual qualities and regions within a quality space. Location represents the fact that the 'individual quality x is located in the region y at time t'. Instances of the class 'Location' are linked to instances of the classes 'IndividualQuality', 'Region', and 'TimeInterval' via the functional object properties 'lc_arg1_quality', 'lc_arg2_region' and 'lc_arg3_time' respectively.
Aboutness$_1$	Subclass of ReifiedRelation. Aboutness$_1$ is the relation between mental states and concepts (more precisely, those concepts that are intentional contents). Aboutness$_1$ represents the fact that the 'mental state x is about the concept y at time t'. Instances of the class 'Aboutness$_1$' are linked to instances of the classes 'MentalState', 'Concept', and 'TimeInterval' via the functional object properties 'about1_arg1_state', 'about1_arg2_concept' and 'about1_arg3_time' respectively.

ClASS	DESCRIPTION
Aboutness$_2$	Subclass of ReifiedRelation. Aboutness$_2$ is the relation between mental states and particulars. Aboutness$_2$ represents the fact that the 'mental state x is About$_2$ the particular y at time t'. Instances of the class 'Aboutness$_2$' are linked to instances of the classes 'MentalState', 'Particular', and 'TimeInterval' via the functional object properties 'about2_arg1_state', 'about2_arg2_particular' and 'about2_arg3_time' respectively

Tab. 3 Object properties

OBJECT PROPERTY	DESCRIPTION
present_at	The relation is used to state the time at which a particular exists. The relation has as domain the class 'Particular' and has as range the class 'Time interval'.
inhere	The relation between an individual quality and the particular that is characterized by such quality. The relation has as domain the class 'IndividualQuality' and has as range the class 'Particular'. The relation has an inverse object property that is called 'has_quality' which has as domain the class 'Particular' and has as range the class 'IndividualQuality'
define	The relation between descriptions and concepts that are defined by such descriptions. The relation has as domain the class 'Description' and has as range the class 'Concept'

Conclusions

As argued across the previous chapters, the new guidelines for PA's services design draw attention to citizen-centric approaches, where the analysis of needs plays a fundamental role to develop more and more efficacious and efficient services. Studying needs-driven services requires taking into consideration cognitive and social aspects, by promoting the symmetrical dialogue between PA and citizens for the purpose to understand and respond to the needs of the latter. Designing a needs-driven service system presupposes a conceptual analysis of how the information required by the system can be organized and represented in a structured and well-founded manner, to promote accessibility and interoperability. Therefore, to manage data in a transparent way, for both artificial and human agents, it is essential to agree on what 'to have a need' exactly means.

Unfortunately, we found that given the various, and often incompatible theoretic hypotheses available, it is far from easy to provide a coherent account of what needs are supposed to be. However, through a careful analysis of the literature, we identified two main ontological categories of needs, that is, absolute needs and instrumental needs. Above all, we emphasized that the difference that runs between such categories depends on establishing whether or not needs are ontologically dependent on goals. While absolutists deny that all needs are necessarily ontologically dependent on goals, instrumentalists state that ontological dependency on goals is a necessary condition for something to be a need. Besides, absolutists claim that absolute needs are those the non-satisfaction of which implies harm. In this respect, we argued that 'harms' fall outside the ontological definitions of needs, they are just consequences of unmet needs, being them absolute or instrumental, based, for example, on physical negative perceptions. Along these lines, we distinguished between a need and the experience of it. A need can be indirectly manifested by means of a feeling, but the need is not itself a feeling.

But at the end of the day, we outlined that defining the nature of goals is the real knot to untie as regards the dispute between instrumentalists and absolutists. Ontologically speaking, we suggested distinguishing between absolute and instrumental needs according to two different notions of goals, namely needs that are related to pseudo goals (i.e. functions of organisms) on the one hand, and needs that are ontologically dependent on goals proper

(i.e. mental representations) on the other. The former correspond to absolute needs while the latter to instrumental needs. In doing so, we attempted to clarify two concepts of 'goal' that are often implicitly used in the literature about needs. Moreover, we underpinned that biological needs are the only kind of absolute needs and that every time that needs are ontologically dependent on goals proper, they should be interpreted as instrumental. More precisely, we highlighted that instrumental needs themselves can be seen as goals proper. Although absolute needs are obviously relevant for human life, we limited our analysis to instrumental needs, since these are the most helpful for designing PA's services. Moreover, we distinguished a need as such, which is a mental state, from what is needed, which is the satisfier that has the function of satisfying a need. From the PA's perspective, satisfiers were treated as the objects (i.e. services) toward which citizens' mental states of need are directed. Studying the relationships between needs and satisfiers, we took into account the theme of intentionality, focusing on the metaphysical problem of intentional objects. To tackle this issue, we introduced our theory of intentional objects seen as roles, which can be applied to all those theories that assume a relational conception of intentionality and posit intentional objects as transcendent objects. Also, we showed how the verb 'need', taken under its instrumental meaning, can be considered, for all intents and purposes, an intentional verb.

After having illustrated various senses of the term 'ontology' in philosophical and information science literature, we articulated and embraced the interdisciplinary ontological perspective of DOLCE. Moreover, taking inspiration from the analysis of BDI models, we claimed that needs are a type of pro-attitude and that, along with intentions, they help to give coherence within the hierarchical structure of means-end reasoning. Hence we provided a formalized ontology of intentional mental states based on DOLCE, using our theory of intentional objects as roles complemented by a TP's view on intentionality and a BDI perspective on practical reasoning. This allowed us to clearly define needs *qua* instrumental goals, besides comparing them with desires conceived of as both instrumental and end goals. Finally, the formalized concepts have been used to develop an ontology for representing needs-driven services in Protégé-OWL as a starting point that allows service designers to link needs to services by adopting a means-end reasoning perspective, focusing on citizens' mental states.

Regarding the limits of our approach, a couple of things should be noted. First of all, with respect to the metaphysical problem of intentional objects, philosophically speaking, our theory has the limitation of not being able to account for those perspectives that see intentional objects as immanent objects; more generally, it is unable to explain a non-

relational conception of intentionality. On the other hand, our proposal has the obvious advantage of accounting for theories that have mutually exclusive ontological assumptions, being applicable to philosophical outlooks that are ontologically committed only to existent objects as well as to those that contemplate nonexistent and impossible objects. Secondly, concerning the applied side of the research, our ontology of mental states for PA's services is limited to the analysis of needs in comparison to desires, but it would require to be extended to the study of other mental states, such as beliefs, intentions, and plans, as well as to the relationships between all these mental states. Future work shall be dedicated to provide a sufficiently clear picture of how agents combine their mental states in order to achieve goals within the practical reasoning framework. In particular, it would be interesting to account for expectations as mental states closely related to the value attributable to the fulfillment of the end goal. For instance, seeing needs as instrumental goals, we must obtain what we need before and for obtaining what we aim at, namely, the end goal. But if the need is not satisfied, then the agent's expectations about the end goal are frustrated. Intuitively, the higher the frustration, the higher the value which has been ascribed to the end goal achievement on the basis of certain expectations.

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Appendix: Ontology in RDF/XML

```
<?xml version="1.0"?>
<rdf:RDF xmlns="urn:absolute:Mentalstatesontology#"
     xml:base="urn:absolute:Mentalstatesontology"
     xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:owl="http://www.w3.org/2002/07/owl#"
     xmlns:xml="http://www.w3.org/XML/1998/namespace"
     xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
     xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
    <owl:Ontology rdf:about="urn:absolute:Mentalstatesontology"/>



    <!--

///////////////////////////////////////////////////////////////////////////
//////////////
    //
    // Object Properties
    //

///////////////////////////////////////////////////////////////////////////
//////////////
     -->




    <!-- fhkb-a2#about2_arg1_state -->

    <owl:ObjectProperty rdf:about="fhkb-a2#about2_arg1_state">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Aboutness2"/>
        <rdfs:range rdf:resource="fhkb-a2#MentalState"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&apos;aboutness2&apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#about2_arg3_time -->

    <owl:ObjectProperty rdf:about="fhkb-a2#about2_arg3_time">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Aboutness2"/>
        <rdfs:range rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&apos;aboutness2&apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#define -->
```

```
    <owl:ObjectProperty rdf:about="fhkb-a2#define">
        <rdfs:subPropertyOf
rdf:resource="http://www.w3.org/2002/07/owl#topObjectProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Description"/>
        <rdfs:range rdf:resource="fhkb-a2#Concept"/>
        <rdfs:comment>The relation between descriptions and concepts that
are defined by such descriptions</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#has_quality -->

    <owl:ObjectProperty rdf:about="fhkb-a2#has_quality">
        <owl:inverseOf rdf:resource="fhkb-a2#inhere"/>
        <rdfs:domain rdf:resource="fhkb-a2#Particular"/>
        <rdfs:range rdf:resource="fhkb-a2#IndividualQuality"/>
    </owl:ObjectProperty>



    <!-- fhkb-a2#inhere -->

    <owl:ObjectProperty rdf:about="fhkb-a2#inhere">
        <rdfs:domain rdf:resource="fhkb-a2#IndividualQuality"/>
        <rdfs:range rdf:resource="fhkb-a2#Particular"/>
        <rdfs:comment>The relation between an individual quality and the
particular that is characterized by such quality.</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#lc_arg1_quality -->

    <owl:ObjectProperty rdf:about="fhkb-a2#lc_arg1_quality">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Location"/>
        <rdfs:range rdf:resource="fhkb-a2#IndividualQuality"/>
        <rdfs:comment>property introduced to reify the ternary relation
&amp;apos;location&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#lc_arg2_region -->

    <owl:ObjectProperty rdf:about="fhkb-a2#lc_arg2_region">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Location"/>
        <rdfs:range rdf:resource="fhkb-a2#Region"/>
        <rdfs:comment>property introduced to reify the ternary relation
&amp;apos;location&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#lc_arg3_time -->

    <owl:ObjectProperty rdf:about="fhkb-a2#lc_arg3_time">
```

```
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Location"/>
        <rdfs:range rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&apos;location&apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#pc_arg1_object -->

    <owl:ObjectProperty rdf:about="fhkb-a2#pc_arg1_object">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Participation"/>
        <rdfs:range rdf:resource="fhkb-a2#Object"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&apos;participation&apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#pc_arg2_event -->

    <owl:ObjectProperty rdf:about="fhkb-a2#pc_arg2_event">
        <rdfs:subPropertyOf
rdf:resource="http://www.w3.org/2002/07/owl#topObjectProperty"/>
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Participation"/>
        <rdfs:range rdf:resource="fhkb-a2#Event"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&apos;participation&apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#pc_arg3_time -->

    <owl:ObjectProperty rdf:about="fhkb-a2#pc_arg3_time">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Participation"/>
        <rdfs:range rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&apos;participation&apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- fhkb-a2#present_at -->

    <owl:ObjectProperty rdf:about="fhkb-a2#present_at">
        <rdfs:domain rdf:resource="fhkb-a2#Particular"/>
        <rdfs:range rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:comment>The relation is used to state the time at which a
particular exists</rdfs:comment>
    </owl:ObjectProperty>
```

```
    <!-- urn:absolute:Mentalstatesontology#about1_arg1_state -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#about1_arg1_state">
        <rdfs:subPropertyOf
rdf:resource="http://www.w3.org/2002/07/owl#topObjectProperty"/>
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Aboutness1"/>
        <rdfs:range rdf:resource="fhkb-a2#MentalState"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;aboutness1&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- urn:absolute:Mentalstatesontology#about1_arg2_concept -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#about1_arg2_concept">
        <rdfs:subPropertyOf
rdf:resource="http://www.w3.org/2002/07/owl#topObjectProperty"/>
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Aboutness1"/>
        <rdfs:range rdf:resource="fhkb-a2#Concept"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;aboutness1&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- urn:absolute:Mentalstatesontology#about1_arg3_time -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#about1_arg3_time">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Aboutness1"/>
        <rdfs:range rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;aboutness1&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- urn:absolute:Mentalstatesontology#about2_arg2_particular -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#about2_arg2_particular">
        <rdfs:subPropertyOf
rdf:resource="http://www.w3.org/2002/07/owl#topObjectProperty"/>
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#Aboutness2"/>
        <rdfs:range rdf:resource="fhkb-a2#Particular"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;aboutness2&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>
```

```
    <!-- urn:absolute:Mentalstatesontology#cf_arg1_particular -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#cf_arg1_particular">
        <rdfs:subPropertyOf
rdf:resource="http://www.w3.org/2002/07/owl#topObjectProperty"/>
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain
rdf:resource="urn:absolute:Mentalstatesontology#Classification"/>
        <rdfs:range rdf:resource="fhkb-a2#Particular"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;classification&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- urn:absolute:Mentalstatesontology#cf_arg2_concept -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#cf_arg2_concept">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain
rdf:resource="urn:absolute:Mentalstatesontology#Classification"/>
        <rdfs:range rdf:resource="fhkb-a2#Concept"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;classification&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!-- urn:absolute:Mentalstatesontology#cf_arg3_time -->

    <owl:ObjectProperty
rdf:about="urn:absolute:Mentalstatesontology#cf_arg3_time">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain
rdf:resource="urn:absolute:Mentalstatesontology#Classification"/>
        <rdfs:range rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:comment>Property introduced to reify the ternary relation
&amp;apos;classification&amp;apos;</rdfs:comment>
    </owl:ObjectProperty>



    <!--

///////////////////////////////////////////////////////////////////////
//////////////
    //
    // Data properties
    //

///////////////////////////////////////////////////////////////////////
//////////////
     -->
```

```
    <!-- urn:absolute:Mentalstatesontology#dateOf -->

    <owl:DatatypeProperty
rdf:about="urn:absolute:Mentalstatesontology#dateOf">
        <rdf:type
rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
        <rdfs:domain rdf:resource="fhkb-a2#TimeIntervalRegion"/>
        <rdfs:range
rdf:resource="http://www.w3.org/2001/XMLSchema#dateTime"/>
    </owl:DatatypeProperty>



    <!--

////////////////////////////////////////////////////////////////////////
//////////////
    //
    // Classes
    //

////////////////////////////////////////////////////////////////////////
//////////////
     -->



    <!-- fhkb-a2#Aboutness1 -->

    <owl:Class rdf:about="fhkb-a2#Aboutness1">
        <rdfs:subClassOf rdf:resource="fhkb-a2#ReifiedRelation"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#about1_arg1_state"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#MentalState"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#about1_arg2_concept"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Concept"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#about1_arg3_time"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#TimeIntervalRegion"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Aboutness1   is the relation between mentalstates
and concepts (more precisely, those concepts that are intentional
contents). Aboutness1    represents the fact that the â€˜mental state x
is about the concept y at time tâ€™. Instances of the class
```

```
â€˜Aboutness1â€™ are linked to instances of the classes
â€˜MentalStateâ€™, â€˜Conceptâ€™, and â€˜TimeIntervalâ€™ via the
functional object properties â€˜about1_arg1_stateâ€™,
â€˜about1_arg2_conceptâ€™ and â€˜about1_arg3_timeâ€™
respectively.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Aboutness2 -->

    <owl:Class rdf:about="fhkb-a2#Aboutness2">
        <rdfs:subClassOf rdf:resource="fhkb-a2#ReifiedRelation"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-
a2#about2_arg1_state"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#MentalState"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#about2_arg3_time"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#TimeIntervalRegion"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#about2_arg2_particular"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Particular"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Aboutness2  is the relation between mentals states
and particulars. Aboutness2  represents the fact that the â€˜mental state
x is About2 the particular y at time tâ€™. Instances of the class
â€˜Aboutness2â€˜ are linked to instances of the classes
â€˜MentalStateâ€™, â€˜Particularâ€™, and â€˜TimeIntervalâ€™ via the
functional object properties â€˜about2_arg1_stateâ€™,
â€˜about2_arg2_particularâ€™ and â€˜about2_arg3_timeâ€™
respectively</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#AgentivePhysicalObject -->

    <owl:Class rdf:about="fhkb-a2#AgentivePhysicalObject">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Object"/>
        <rdfs:comment>e.g. a human person</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Concept -->

    <owl:Class rdf:about="fhkb-a2#Concept">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Particular"/>
        <owl:disjointWith rdf:resource="fhkb-a2#Event"/>
        <owl:disjointWith rdf:resource="fhkb-a2#Object"/>
```

```
        <owl:disjointWith rdf:resource="fhkb-a2#Region"/>
        <rdfs:comment>Concepts are intensional properties. However, in
DOLCE-CORE concepts have been &amp;apos;reified&amp;apos; to be able to predicate
on them using First-order logic, so they have been treated as
&amp;apos;first-class citizens&amp;apos;, i.e. individuals. More specifically,
concepts are particulars that are created and accepted by a community of
intentional agents and defined by descriptions encoded in linguistic
expressions. Concepts can classify different kinds of particulars. For
instance, with respect to PA&amp;apos;s services domain, â€œProviding a child
benefitâ€ can be seen as a concept whose description is recorded in
PAâ€™s official documents. Each service provision counts as a single
event that is classified by the concept defined by the
description.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#D1-iGoalState -->

    <owl:Class rdf:about="fhkb-a2#D1-iGoalState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#DesireState"/>
        <rdfs:comment>D1-iGoals states are desires that have been
selected by an agent to be pursued (i.e goals). More specifically, they
represent desires qua instrumental goals whose satisfiers, if realized,
create sufficient conditions to achieve the related end
goal.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#D2-eGoalState -->

    <owl:Class rdf:about="fhkb-a2#D2-eGoalState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#DesireState"/>
        <rdfs:comment>D2-iGoals states are desires that have been
selected by an agent to be pursued (i.e goals). More specifically, they
represent  desires that are conceived of as end goals, i.e. goals that
are pursued per se</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Description -->

    <owl:Class rdf:about="fhkb-a2#Description">
        <rdfs:subClassOf rdf:resource="fhkb-a2#SocialObject"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#define"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Concept"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Descriptions are created, starting at their first
encoding in a public language, by communities of intentional agents.
Within the domain of PA&amp;apos;s services, public policies can be seen as
descriptions that define concepts such as â€˜health servicesâ€™,
â€˜transport servicesâ€™, etc</rdfs:comment>
    </owl:Class>
```

```
    <!-- fhkb-a2#DesireState -->

    <owl:Class rdf:about="fhkb-a2#DesireState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#MentalState"/>
        <rdfs:comment>e.g. Johnâ€™s desire to win the
election</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Event -->

    <owl:Class rdf:about="fhkb-a2#Event">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Particular"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#pc_arg1_object"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#Participation"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#has_quality"/>
                <owl:allValuesFrom rdf:resource="fhkb-
a2#TemporalQuality"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <owl:disjointWith rdf:resource="fhkb-a2#Object"/>
        <owl:disjointWith rdf:resource="fhkb-a2#Region"/>
        <rdfs:comment>Events are â€˜partially presentâ€™, that is at any
given time of their existence, some of their proper temporal parts might
be not present since such parts were present in the past or will be
present in the future. Events are said to â€˜happen in timeâ€™ (e.g. a
symphony, a football match, a university lecture, etc.).</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#IndividualQuality -->

    <owl:Class rdf:about="fhkb-a2#IndividualQuality">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Particular"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#inhere"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Particular"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Individual qualities are a subclass of particulars
that we can perceive or measure (e.g.color, height, temperature, etc).
Individual qualities characterize specific particulars (i.e. two
different particulars cannot have the same quality). Each quality kind is
associated with one or more qualities spaces. Individual qualities have
locations in quality spaces, that is they are located in a certain point
of such spaces at a certain time (e.g. the shade of red of a particular
rose is located at a point x at time t in the color space). Within
PA&amp;apos;s service domain, individual qualities are useful to characterize
different types of services and agents who take part in the service
lifecycle.</rdfs:comment>
    </owl:Class>
```

```
    <!-- fhkb-a2#IntentionalContent -->

    <owl:Class rdf:about="fhkb-a2#IntentionalContent">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Role"/>
        <rdfs:comment>Intentional contents are a kind of mediating
entities by which mental states can manage to indirectly refer to
objects, provided that such objects exist. Within PA&amp;apos;s services
domain, mental states of need are attributed to citizens together with
intentional contents of such states. From PA&amp;apos;s perspective,
citizens&amp;apos; intentional contents coincide with concepts that express
services.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#IntentionalObject -->

    <owl:Class rdf:about="fhkb-a2#IntentionalObject">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Role"/>
        <rdfs:comment>The role of the intentional object can be played by
any particular that satisfy a certain concept. Particulars that satisfy
concepts are those objects toward which mental states are about. Within
PA&amp;apos;s service domain, a single service provision, classified by the
related concept, counts as a particular that plays the role of
intentional object with respect to citizens&amp;apos; mental states of
need.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Location -->

    <owl:Class rdf:about="fhkb-a2#Location">
        <rdfs:subClassOf rdf:resource="fhkb-a2#ReifiedRelation"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#lc_arg1_quality"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#IndividualQuality"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#lc_arg2_region"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Region"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#lc_arg3_time"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#TimeIntervalRegion"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Location is the relation between individual
qualities and regions within a quality space. Location represents the
fact that the â€˜individual quality x is located in the region y at time
tâ€™. Instances of the class â€˜Locationâ€™ are linked to instances of
```

```
the classes â€˜IndividualQualityâ€™, â€˜Regionâ€™, and â€˜TimeIntervalâ€™
via the functional object properties â€˜lc_arg1_qualityâ€™,
â€˜lc_arg2_regionâ€™ and â€˜lc_arg3_timeâ€™ respectively.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#MentalState -->

    <owl:Class rdf:about="fhkb-a2#MentalState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#State"/>
        <rdfs:comment>e.g. beliefs, desires, needs, intentions, hopes,
goals, etc.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#N1-iGoalState -->

    <owl:Class rdf:about="fhkb-a2#N1-iGoalState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#NeedState"/>
        <rdfs:comment>N1-iGoal states are needs that have been selected
by an agent to be pursued (i.e goals). More specifically, they represent
those needs qua instrumental goals whose satisfiers, if realized, create
sufficient conditions to achieve the end goal.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#N2-iGoalState -->

    <owl:Class rdf:about="fhkb-a2#N2-iGoalState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#NeedState"/>
        <rdfs:comment>N2-iGoal states are needs that have been selected
by an agent to be pursued (i.e goals). More specifically, they represent
those needs qua instrumental goals whose satisfiers, if realized, create
necessary and sufficient conditions to achieve an end
goal.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#NeedState -->

    <owl:Class rdf:about="fhkb-a2#NeedState">
        <rdfs:subClassOf rdf:resource="fhkb-a2#MentalState"/>
        <rdfs:comment>e.g. John&apos;s need to receive some additional
income</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#NonAgentivePhysicalObject -->

    <owl:Class rdf:about="fhkb-a2#NonAgentivePhysicalObject">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Object"/>
        <rdfs:comment>e.g.a desk, a house, a vehicle, etc</rdfs:comment>
    </owl:Class>
```

```
    <!-- fhkb-a2#NonPhysicalQuality -->

    <owl:Class rdf:about="fhkb-a2#NonPhysicalQuality">
        <rdfs:subClassOf rdf:resource="fhkb-a2#IndividualQuality"/>
        <rdfs:comment>e.g. the value of a building</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#NonPhysicalRegion -->

    <owl:Class rdf:about="fhkb-a2#NonPhysicalRegion">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Region"/>
        <rdfs:comment>e.g. 20 Euro value</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Object -->

    <owl:Class rdf:about="fhkb-a2#Object">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Particular"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#pc_arg2_event"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#Participation"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#has_quality"/>
                <owl:allValuesFrom rdf:resource="fhkb-
a2#PhysicalQuality"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <owl:disjointWith rdf:resource="fhkb-a2#Region"/>
        <rdfs:comment>Objects are said to be â€˜wholly presentâ€™, that
is all their proper parts are present at any time of their existence
(e.g. chairs, trees, persons, cars, etc.)</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Participation -->

    <owl:Class rdf:about="fhkb-a2#Participation">
        <rdfs:subClassOf rdf:resource="fhkb-a2#ReifiedRelation"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#pc_arg1_object"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Object"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#pc_arg2_event"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Event"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
```

```
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#pc_arg3_time"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#TimeIntervalRegion"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Participation is the main relation between objects
and events and represents the fact that the â€˜object x participates in
event y at time tâ€™. Instances of the class â€˜Participationâ€™ are
linked to instances of the classes â€˜Objectâ€™, â€˜Eventâ€™, and
â€˜TimeIntervalâ€™ via the functional object properties
â€˜pc_arg1_objectâ€™, â€˜pc_arg2_eventâ€™ and â€˜pc_arg3_timeâ€™
respectively.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Particular -->

    <owl:Class rdf:about="fhkb-a2#Particular">
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#present_at"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#TimeIntervalRegion"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>DOLCE-CORE is an ontology of temporal particulars
or individual, that is its domain or universe of discourse (i.e. the
entire range of entities that are assumed to exist) includes only
individuals that exist in time. Temporal existence is expressed by the
binary predicate PRE (x, t) that stands for â€˜the entity x is present at
tâ€™. The most basic ontological categories of DOLCE-CORE are six, that
is object, event, individual qualitiy, region, concept, and arbitrary
sum. Yet, the category arbitrary sum is not represented here since it is
not relevant for our modelling purposes.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#PhysicalQuality -->

    <owl:Class rdf:about="fhkb-a2#PhysicalQuality">
        <rdfs:subClassOf rdf:resource="fhkb-a2#IndividualQuality"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#inhere"/>
                <owl:allValuesFrom rdf:resource="fhkb-a2#Object"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <owl:disjointWith rdf:resource="fhkb-a2#TemporalQuality"/>
        <rdfs:comment>e.g. being space-located, weight, shape,
etc.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#PhysicalRegion -->

    <owl:Class rdf:about="fhkb-a2#PhysicalRegion">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Region"/>
```

```
        <rdfs:comment>e.g. the Euclidean space</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Region -->

    <owl:Class rdf:about="fhkb-a2#Region">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Particular"/>
        <rdfs:comment>Regions represent the location of individual
qualities that inhere to particulars within a quality space at a certain
time. Similar to concepts, regions are created by a community of
intentional agents (e.g. the particular â€˜x is high 2m at time tâ€™
means that there is a quality y that inhere to x such that y is of the
quality kind â€˜heightâ€™ and y is located in the 2m region within the
height quality space at time t).</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#ReifiedRelation -->

    <owl:Class rdf:about="fhkb-a2#ReifiedRelation">
        <rdfs:comment>Due to limitations of the expressivity of OWL
language, it is possible to express properties only in the form of binary
relations. So to represent n-ary relations (i.e. relations among more
than two arguments) that are present within our ontology, following the
standard method used in the semantic web community , we have had to reify
some properties making them â€˜first-class citizensâ€™. So for each n-ary
relation, we have created a correspondent class and n new properties
meant to represent such relations.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Role -->

    <owl:Class rdf:about="fhkb-a2#Role">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Concept"/>
        <rdfs:comment>Examples are &apos;being a student&apos;,
&apos;being a president&apos; etc. Roles are said to be
&apos;founded&apos;, which means, very roughly, that they are thought of
in terms of relation to other entities (e.g. being a PhD student implies
being enrolled in a university). Furthermore, roles are anti-rigid, that
is, they show a dynamic temporal relation with respect to entities by
which they are played, in the sense that: a) the same entity could play
different roles simultaneously or at different times; b) the same entity
could play the same roles several times; c) different entities could play
the same role at different times.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#Service -->

    <owl:Class rdf:about="fhkb-a2#Service">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Event"/>
        <rdfs:comment>Services represent the satisfiers (i.e. whatever
has the function of satisfying a need) of citizens&apos; mental states of
need. Examples of services are providing a child benefit, releasing a
license, providing home care for older adults, etc.</rdfs:comment>
```

```
    </owl:Class>



    <!-- fhkb-a2#SocialObject -->

    <owl:Class rdf:about="fhkb-a2#SocialObject">
        <rdfs:subClassOf rdf:resource="fhkb-
a2#NonAgentivePhysicalObject"/>
        <rdfs:comment>e.g. laws,  agreements, certificates,
etc.</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#State -->

    <owl:Class rdf:about="fhkb-a2#State">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Event"/>
        <rdfs:comment>â€˜Maria&apos;s waiting for a callâ€™ is an example
of state. States are homeomeric (i.e. all their temporal parts are
described by the very same expression used to refer to the whole event)
and cumulative (i.e the mereological sum of two instances of the same
event-type maintains the same event-type).</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#TemporalQuality -->

    <owl:Class rdf:about="fhkb-a2#TemporalQuality">
        <rdfs:subClassOf rdf:resource="fhkb-a2#IndividualQuality"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#inhere"/>
                <owl:allValuesFrom rdf:resource="fhkb-a2#Event"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>e.g. the duration of services</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#TemporalRegion -->

    <owl:Class rdf:about="fhkb-a2#TemporalRegion">
        <rdfs:subClassOf rdf:resource="fhkb-a2#Region"/>
        <rdfs:comment>e.g. a date such as â€˜14th   January
2021â€™</rdfs:comment>
    </owl:Class>



    <!-- fhkb-a2#TimeIntervalRegion -->

    <owl:Class rdf:about="fhkb-a2#TimeIntervalRegion">
        <rdfs:subClassOf rdf:resource="fhkb-a2#TemporalRegion"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty rdf:resource="fhkb-a2#pc_arg3_time"/>
```

```
                <owl:someValuesFrom rdf:resource="fhkb-
a2#Participation"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>e. g. one second, minute, hour, day,
etc.</rdfs:comment>
    </owl:Class>



    <!-- urn:absolute:Mentalstatesontology#Classification -->

    <owl:Class
rdf:about="urn:absolute:Mentalstatesontology#Classification">
        <rdfs:subClassOf rdf:resource="fhkb-a2#ReifiedRelation"/>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#cf_arg1_particular"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Particular"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#cf_arg2_concept"/>
                <owl:someValuesFrom rdf:resource="fhkb-a2#Concept"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:subClassOf>
            <owl:Restriction>
                <owl:onProperty
rdf:resource="urn:absolute:Mentalstatesontology#cf_arg3_time"/>
                <owl:someValuesFrom rdf:resource="fhkb-
a2#TimeIntervalRegion"/>
            </owl:Restriction>
        </rdfs:subClassOf>
        <rdfs:comment>Classification is the relation between concepts and
other particulars. Concepts classify particulars that satisfy all the
constraints in the concept definition. Classification represents the fact
that the  â€˜concept x classifies particular y at time tâ€™. Instances of
the class â€˜Classificationâ€™ are linked to instances of the classes
â€˜Conceptâ€™, â€˜Particularâ€™, and â€˜TimeIntervalâ€™ via the
functional object properties â€˜cf_arg1_conceptâ€™,
â€˜cf_arg2_particularâ€™ and â€˜cf_arg3_timeâ€™
respectively</rdfs:comment>
    </owl:Class>
</rdf:RDF>



<!-- Generated by the OWL API (version 4.2.8.20170104-2310)
https://github.com/owlcs/owlapi -->
```