Chapter 2
Towards Design of High-Level Synthetic Sensors for Socially-Competent Computing Systems

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ABSTRACT

The chapter presents a conceptual model for high-level synthetic sensor design in present-day Web x.0 mediated socially-competent computing systems. The aim is design of computing systems that are able to operate on the social level of description of a situation in a way similar to people reading social cues. The overall perceptive ability of human vision relies on high level, integrative sensors for detecting complex diffuse influences. It is proposed by the current approach that the recognition of the agent's attitude by the synthetic sensor can help identify correctly the intention for the action by considering the attitude being the more general context of the emerging situation-dependent intention. Possibilities for application of the proposed theoretical approach to education of people with special learning needs or style are discussed.

INTRODUCTION

Modern image processing systems that are recording people and their interactions (lifelogging cameras, Kinect sensors, social robots, etc.) collect enormous amount of data which is being processed in time and effort consuming way, yet far from being sufficiently competent to be reliable in performance. Most computing algorithms aim at modeling people as physical objects in dynamic interactions (e.g. Oliver, Rosario, & Pentland, 2000; Heïgeas, Luciani, Thollot, & Castagné, 2010; Kaburlasos & Papakostas, 2015). Apart from identifying other people as physical objects, human perception is capable of simultaneously identifying *social interaction cues* as well as *psychological features* that are necessary for adapting to life in the society (Forsyth, 1990; Pentland, 2007; Hari, & Kujala, 2009; Perry, Stein, & Bentin, 2011; Dimitrova, 2012). To achieve better social competence the computing systems need to be able to *identify the underlying processes* guiding human interactions by extracting relevant features of the perceived information for the respective abstract level of analysis by being equipped with *high-level sensors* for capturing and integrating multilevel sensor stimulation.

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The main focus of the current chapter is the ability of a computing system to operate on the social level of description of a situation by reading the relevant cues by especially designed sensors, called *high-level sensors,* in a way similar to people reading social cues. The possibilities for application of the proposed theoretical approach to education of people with special learning needs or style are briefly discussed.

Background

Many current approaches to *social sensor* design apply the analogy with pattern recognition theories or image processing methodology. Indicators of the social nature of the object – the human – are the signifiers of social interactions and social signaling – voice intonation, hand gestures, flow of speech, posture, facial expression, etc. (Kopp, & Wachsmuth, 2004; Pentland, 2007; Pan, Cebrian, Dong, Kim, & Pentland, 2010; Courgeon, Grynszpan, Buisine, & Martin, 2012). The main approach to modeling the nature of the interaction is based on collecting sets of features and classifying behavioral patterns, belonging to different social situations (e.g. Hernandez, Reyes, Escalera, & Radeva, 2010; Kim, Helal, & Cook, 2010; Courgeon et al., 2012). Sequences of behaviors are modeled via Hidden Markov Models (Pan et al., 2010), Gaussian Mixture Models (Hernandes et al., 2010), Conditional Random Field (Kim et al., 2010), Laban movement theory (Lourens, van Berkel, & Barakova, 2010), F-formations (Hung & Krose, 2011), T-patterns (Magnusson, 2000; Jonsson, 2006), convolutional neural networks (Bolaños, Garolera, M., & Radeva, 2015), interactive fuzzy lattice reasoning (Kaburlasos & Papakostas, 2015) and other machine learning approaches. Considering that, as physical objects, people are flexible in behavior and of changing appearances, it is insufficient to simply apply the developed techniques for object and pattern recognition in other domains for detecting *social presence* in a situation (e.g. Groh, Lehmann, Reimers, Frieß, & Schwarz, 2010). Social presence is revealed by subtle cues suggesting the *attentiveness* of the agent to the social configuration between the present agents, not just their physical proximity. This attentiveness is being qualified by the observer as *attitude* such as being polite, impatient, empathic, etc.

It turns out that current image processing systems are capable of *predicting behavior* in response to *behavior* based on modeling people as physical objects in dynamic interactions. Next step is augmenting the computational systems with the ability to extract the relevant cues and to achieve better *social communication competence*, similar to the kind that is underlying human interactions. This will allow developing algorithms for predicting the outcomes of social interactions – whether conflict or consensus will result – from reading behavioral patterns in different modalities – visual (facial expressions, gestures), auditory (prosody), tactile (clash), organized in unambiguous, or integrated, sets of features. The computational system will achieve the competence of *predicting behavior* in response to *attitude* – friendly, supportive, empathic, hostile, distant, etc. – in a manner similar to the way people acquire *social communication competence* for better adaptation to life in the society.

Novel Context for Social Sensor Design in Web-based Systems

Some of the high-level synthetic sensors are called social sensors and are being designed to detect aspects of human-human, human-avatar and human-robot interaction that are conveyed by the nature of the *social communication* process, in particular in a Web 2.0 environment. Within the recent years, moreover, several generations of Web have emerged leading to more complex and ubiquitous Web presence in people's life. For instance, D. Nations (Nations, 2015) foresees the current existence of three Web generations – Web 1.0, 2.0 and 3.0. Next, J. Fowler and E. Rodd (Fowler & Rodd, 2015) propose

Table 1. Meta-features for distinguishing between the Web generations

No	Meta-features of Web generations	Definitions
1	The Artificially Intelligent Web x.0.	Variety of search options by conventional search engines or using social bookmarking as a search engine, being able "to learn how to separate the good from the bad"
2	The Web x.0 Semantic Web	A combination of artificial intelligence and the semantic web approaches to extracting meaning from the text and understanding it by the computer in a similar to the human way
3	The World Wide Virtual Web x.0	The "idea that the entire web would evolve into one single virtual world with buildings, shops, and other areas to explore and people to interact with" is combined with novel means of interaction with the "outernet" (Rehder, & Hentschel, 2009) by gestures, biometric data, brain-computer interface, etc.
4	The Ever-Present Web x.0.	"Internet access on our mobile devices (cell phones, smartphones, pocket pcs) …will make the Internet always present in our lives: at work, at home, on the road, out to dinner, wherever we go, the Internet will be there", making the need for personal assistants – robots/agents/avatars – necessary to mediate user adaptation to the newly emerging Web x.0 environments
5	*The Initiative-taking Web x.0*	*The ability of the personal agent/avatar/robot to take initiative on their own and on behalf of the user*

the "ultra-intelligent agent" to whom the user will be able to give a *personality*, as main feature of the emerging Web 4.0. That is, the agent will give advice, express concern with user's health and will remind of forgotten items. This will be achieved by incorporating *high-level synthetic sensors* for understanding *attitudes* by extracting relevant *social cues* in analyzing the observed behavior. For example, Jibo (e.g. Rane, Mhatre, & Kurup, 2014) and Pepper (e.g. Guizzo, 2014) are two robotic agents designed especially for *socially competent communication* with the users and possessing *personality* as their distinguishing feature. These are intended to live at home and make the most of the Web in assisting and advising the user on health, diet, emotional support, etc.

The Symbionet was proposed by K. Patel (Patel, 2013), following H. Nasser (Nasser, 2011), as Web 5.0 generation, where every user will have a personal Avatar, taking care of the individual preferences in using Web based services and, at the same time, of personal security in the complex data exchange flows. The main meta-features being, according to D. Nations, the basis for distinguishing between different Web generations are presented in Table 1, lines 1 - 4 (Nations, 2015).

In the present chapter a fifth meta-feature is proposed, which is defined as the ability of the personal agent/avatar/robot to *take initiative* on their own and on behalf of the user (line 5 of Table 1).

It is also proposed in the chapter to consider an undefined number of Web generations, depending on the technical solutions that will be implemented in future browsers, processors, memories and interfaces, which can be labeled as Web x.0 solutions.

HIGH-LEVEL SYNTETIC SENSOR DESIGN

Abstract Levels for Analysis of the Observed Human Behavior

In human society people make predictions of other peoples' behaviors in response to social and psychological drives like *attitudes* and *opinions*, rather than simply responding to the strength and direction of

the observed *physical* actions. A social situation involves interactions that are conditional on the underlying *social context* to a greater extent than to the immediate physical interaction. If a person stumbles on another person's foot, it is more likely that the person apologizes and receives a smile in response, than a physical counteraction. The outcome of the situation can be predicted only if the *intention* for the action has already been unambiguously recognized (e.g. De Ruiter & Cummins, 2012). If the receiver is of negative attitude at the moment of the physical contact, however, a conflict may result. It is proposed by the current approach that the recognition of the agent's *attitude* can help identify correctly the *intention* for the action by considering the attitude being the more general context of the emerging situation-dependent intention.

It was proposed to distinguish three abstract levels for analysis of the observed human behavior – *physical*, *social* and *psychological* (Dimitrova, 2012). If our system is capable of predicting behavior in response to behavior, it operates on the *physical level* of description of the observed situations. If the computing system is capable of predicting behavior in response to attitudes – then it operates on the *social level* of description of the observed behavior. Whenever people describe other people's behavior as opinion-driven – then they provide interpretation on the *psychological level* of description of the observed behavior. The physical level is considered the outer, surface level of behavior description. The inner, deep level as a determinant of behavior is the psychological level. It was proposed in (Dimitrova, 2012) and subsequently argued in robotic context in (Dimitrova & Wagatsuma, 2015) to focus mainly on the intermediate – social level of analysis, prediction and modeling of human behavior in design of Web mediated user-assistive technology.

Designing integrative high-level synthetic sensors makes possible to increase the intelligence of the computing system to the level of *social interaction understanding* by making it capable of *predicting behavior in response to attitude.* It is important to make the *socially competent* computing system capable of *introducing structure* and *functioning* in social situations, like technology-mediated education (Dimitrova, 2008; Dimitrova, Vegt & Barakova, 2012; Kalamkarian, H. S., & Karp, 2015), social robotics (Barakova & Lorens, 2010, Barakova & Vanderelst, 2011; Dimitrova, Wagatsuma, Tripathi, & Ai, 2015), wearable systems using biometric data (Casale, Pujol, & Radeva, 2011), lifelogging systems (e. g. Hopfgartner, Yang, Zhou, & Gurrin, 2013) and others.

Modeling Social Competence by High-Level Synthetic Sensors

Modeling social competence in computing systems is being currently made within social network theory based approaches (e.g. Bottazzi, Montanari, & Toninelli; 2007; Escalera, Radeva, Vitrià, Baró, & Raducanu 2010; Thakur, Helmy, & Hsu, 2010). Binder, Roberts, & Sutcliffe (2012) discriminate "core ties" and "significant ties" in terms of alter-ego relationships. It is shown that many of the cues for personal closeness in a social network are under the surface and not revealed by simply counting the number of calls in one direction. Similar account is provided by Dimitrova, Lekova, & Adda (2010) on identifying close relationships for sharing resource in multi-hop communication networks. In (Binder et al., 2012) the personality account of Oswald, Clark, & Kelly (2004) is employed for defining closeness in social networks. Oswald et al. (2004) propose four set of behaviors comprising the so called by the authors "friendship maintenance" – openness, supportiveness, joint activities and positivity. The main outcome of the study, relevant to the present account, is that these sets of behaviors are not completely independent from each other – they do not represent orthogonal dimensions of human behaviors – but share common features. One of the main issues in designing social sensors is the *orthogonality* assump-

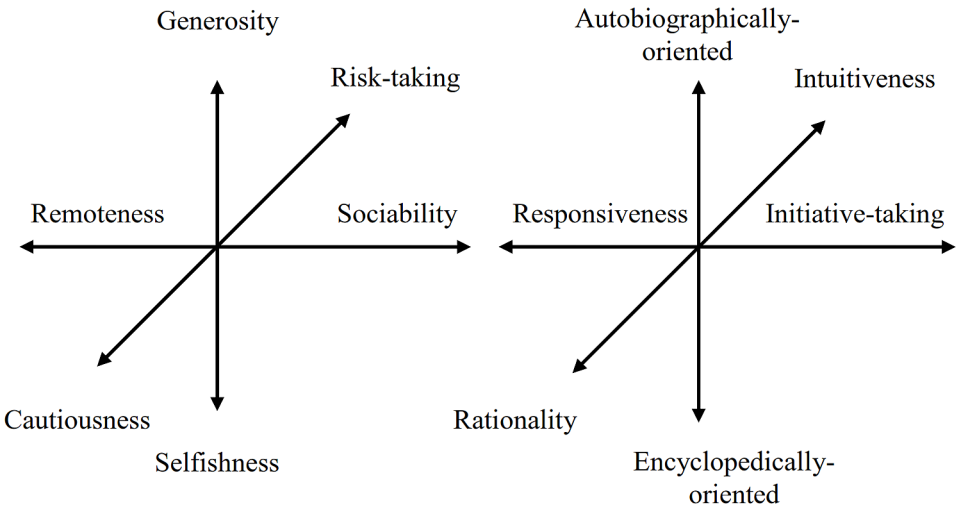
tion – every synthetic sensor needs to be designed as reacting to an unambiguous set of features defining some personality dimension that is with minimal degree of overlap with other personality dimensions. In addition, novel approaches for construct validity testing are needed that are adapted to the novel technological environment of present day society.

Personality Filtering in Socially Competent Computing

A set of social sensors will comprise a *personality filter* for description of people in social situations as *social*, rather than *physical* entities, whose behaviors are driven by their attitudes towards the others. Since there is infinite number of features/dimensions of a personality, possible to be modeled in computational systems, the important is the need to choose features that are mutually orthogonal in order to avoid redundant calculations and achieve adequate construct validity. This allows the pragmatic approach to select socially and technologically important situations for analysis of human behavior by socially-competent computing systems. It has been shown that, without modification and simplification of the features that have to be identified, the computing system cannot recognize the dimensions, postulated in traditional personality theories like Eysenk's extroversion/introversion, neuroticism, psychoticism and social desirability theory (Barrett, Petrides, S. Eysenck, & H. Eysenck, 1998), Spielberger's anxiety trait/state model (Spielberger, 2010), face-to-face dominance (Escalera, Martinez, Vitria, Radeva, & Anguera, 2009) and others. For example, an attempt to relate patterns of Facebook usage to personality types was made in (Bachrach, Kosinski, Graepel, Kohli, & Stillwell, 2012). Data taken from the Facebook application called *myPersonality* was analyzed. The application is a questionnaire, revealing the degree to which characteristics are expressed along five dimensions: openness to experience, conscientiousness, extraversion, agreeableness and neuroticism, i.e. the so called Five Factor Model (e.g. Widiger, & Costa, 2012). Patterns of Facebook usage correlated with the degree of expression of extraversion and neuroticism only. Extraverted users of Facebook tend to share more actively events of their lives and more often reach out and interact with other people on Facebook. Users with high scores for neuroticism tend to have positive score correlation with the number of likes and participation in groups. According to the authors, the explanation is in the need to obtain support and reduce anxiety. The other factors reveal much more complicated and less unambiguous picture of correlations with Facebook usage behaviors. Similarly, an attempt to relate performance in serious games with the Mayers-Briggs Type Indicator (MBTI) of personality, defined by "four dichotomous pairs of functions or attitudes" was made in (Menekse, Cagiltay & Ozchelik, 2015). These were: extraversion-introversion, sensing-intuition, thinking-feeling and judging-perceiving. No correlations between game scores and personality types were found. This gives support to the presented in the present chapter theoretical position that the dimensions have to be introduced as un-overlapping and task-relevant characteristics that can be captured by synthetic sensors.

Three dimensions of personality features, assumed orthogonal to each other, were proposed in (Dimitrova, 2012) – generosity, sociability and cautiousness. The proposed socially competent computing system implemented the following social sensors – those identifying *generous*, *sociable* and *cautious attitudes* and predicting the respective behaviors, as illustrated in Figure 1, left. Personality characteristics were represented as orthogonal dimensions, meaning that, presumably, they are independent of each other. Three application scenarios were investigated (Dimitrova, 2012). The first one was generosity in sharing resource in mobile communications. The second was risk-taking in medical interventions. These are intended for emergency situations for urgent data packet forwarding and for adequate task allocation of the rescue team. The third scenario was sociability in the context of Web-mediated educational systems.

Figure 1. Possible personality dimensions for present-day socially-competent computing systems



The present framework is inspired by the personality theory of D. Funder (2006). According to him, personality–dependent behaviors are orthogonal to situation–induced behaviors. Situations may demand particular kinds of behavior and these can also be graded in terms of dynamics and intensity. Along this gradation of the situation demand, however, people preserve style of response to the demand, i.e. preserve the personality-driven behavior relatively to the degree of expression of other personality dimensions. That is, generous people will preserve generosity across situations, which is an independent (i.e. orthogonal) personality future to possible other dimensions.

In the present chapter three new personality dimensions are introduced with the potential to be implemented in high-level synthetic sensors – *responsive* attitude as opposed to being *initiative-taking*; *intuitive* attitude as opposed to being *rational* and *autobiographically-oriented* as opposed to being of *encyclopedic* attitude to learning new knowledge (Figure 1, right).

These dimensions are intended to describe social communication strategies that distinguish one learner from another, yet being universal and neutral in respect to the success expectation when learning new knowledge. They are based on social and cognitive research on human memory (Fivush, 2011; Dimitrova & Wagatsuma, 2011; Lieury, & Lorant, 2013), learning styles (e.g. Pritchard, 2013) and role of intuition in learning (e.g. Sinclair, 2011; Tripathi, Wagatsuma, Dimitrova, Vircikova, & Sinčák, 2015).

In (Dimitrova et al., 2011) the possibility for *gradual expression of a personality feature* was explored. It was shown that, for instance, reasonable and unreasonable (extreme) generosity can have dramatically differing behavioral outcomes depending on the context of the current task demand. In a rescue scenario with limited network resource the unreasonable generosity can be more destructive than being selfish, reasonably or unreasonably. It was shown that not the absolute, but the relative, expression of the characteristics of the personality is more important within contexts. This supports the social dynamics account of communicating via technology (e.g. Davis III, Deil-Amen, Rios-Aguilar, & Gonzalez Canche, 2012). The contextual aspect of modeling the behavioral, social, or personality characteristics is very important and in some cases – crucial for the successful outcome of a social situation mediated either by the internet or by the "outernet" (Rehder, & Hentschel, 2009).

In modeling attitude in interactive systems like adaptive Web interface, personal avatars or assistant robots, one very important social dimension needs to be implemented – the 'affection dimension'. Affection, reinstated by the computing system, can bring confidence to the user especially in learning new knowledge. In human interaction affection is detected by an integrated set of sensor stimulations – gaze, smile, touch, voice modulation etc. The affection sensor will operate on a configuration of stimulations rather than analyzing the stimulations one at a time.

Affection Sensor Design

The overall perceptive ability of human vision relies on high level, integrative sensors for detecting complex diffuse influences like the gaze sensor, for example, proposed by R. Jamisola:

This brings to the idea of the gaze sensor. This is not about detecting the gaze angle through a camera, but this is about endowing to machines an ability to detect that somebody is looking at it, similar to the human experience. (Jamisola, 2014)

Furthermore, the author proposes an integrative view across cognitive levels – from diffuse sensorics through awareness to intentionality:

The device should also be able to distinguish gaze that is coupled with intention against casual gaze or gaze by accident. Collecting a gaze "signal" is already a huge challenge, how much more in identifying if it is coupled with an intention. (Jamisola, 2015)

The main idea is depicted in Figure 2, presenting the cognitive levels 'encompassing' the proposed 'gaze sensor'. It illustrates the idea of the continuum of influences that are accumulated via sensors into a signal of 'awareness' of the 'gaze' that transfuses into intention and in this way changes our behavior. The moment we become aware that we are being looked at, we spontaneously change our nonverbal and verbal behavior – including our posture and facial expression, even the tone of voice and pace of speech. These behavioral changes induce changes in the observer's behavior (very much within a similar respective 'awareness-intention' loop), that stimulate the diffuse sensor influences in a novel next-level cognitive loop.

In Jamisola (2015) an "affection sensor" design is proposed in a similar way. In (Dimitrova & Wagatsuma, 2015) this idea is translated to design of robots with novel roles and social abilities. Figure 3 illustrates the idea of the continuum of influences that are accumulated via sensors into a signal of awareness of the 'affection' expressed by the agent we are communicating with – human, computer-generated avatar, or robot.

From an observer perspective, however, the process of transition from the awareness of a situation to inferring intentions of behavior is not transparent. A 'theory of mind' approach (Lieberman, 2007) would propose to observe and infer the internal, psychological or mental states of the other person/agent. First we notice the diffuse sensor influences, then the emergence of the state of awareness, then the detection of the "gaze" or "affection" and finally we infer the intentions of the other person. In reality, however, this may not occur in this order when we try to observe the internal states of other persons. Most often we notice the action, then we infer the intention, then we notice the signs of affection and finally we focus on the awareness state of the other person regarding the observed socially-relevant cue. A 'mirror neuron'

Figure 2. Cognitive levels encompassing a 'gaze sensor'

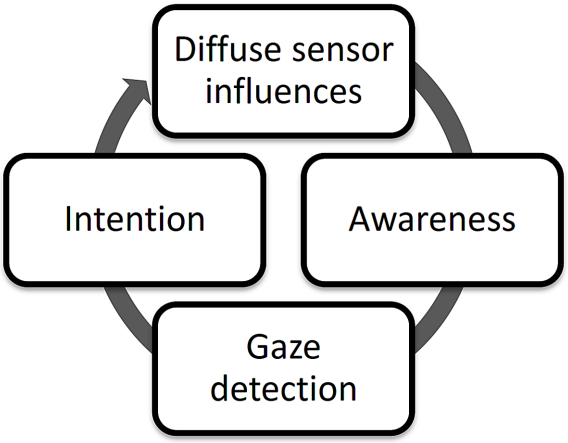
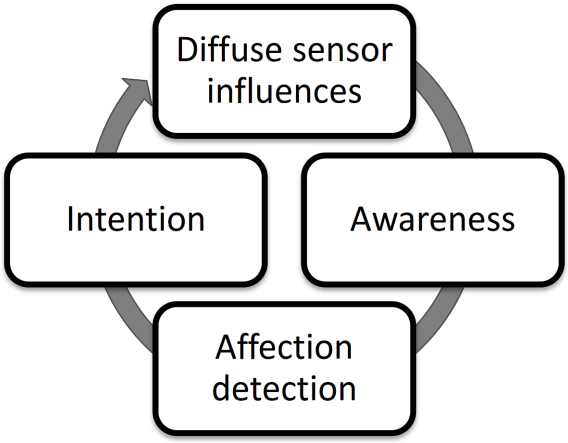


Figure 3. Cognitive levels encompassing an 'affection sensor'



(empathic) account seems more plausible to explain this process than a 'theory of mind' account, stating that empathy is the underlying 'instrument' for social interaction (Rameson, & Lieberman, 2009). The implicit, spontaneous feeling of the other person's emotional state emerges before the actual awareness of the other person's mental state. Within a social cognitive neuroscience account, empathy emerges from diffuse sensor influences being integrated at a subconscious level before bringing the awareness that we experience the feeling of the other person. According to L. Shilbach, social interaction is ontogenetically primary to social observation (Shilbach, 2014). Based on this theory, a framework is proposed where social observation is contained within social interaction as neurologically situated cognitive processes (Dimitrova et al., 2015). An account for the autistic spectrum condition being a function of limited cognitive resource was described. Recommendations for the design of robot-mediated pedagogical situations for children with special learning needs were formulated, based on this theoretical account.

Social Communication Competent Educational Systems for People with Special Learning Needs or Style

Introducing of educational systems with social communication competence often is conditional upon the *perceptual modality* of interaction with the learner, or at least on defining the leading one. Gesture-based human-robot communication is helpful not only in cases with hearing difficulties. It is also necessary for making the interaction with the learner more 'natural', even when hearing is preserved, but more central brain functions are impaired. The main challenge is defining dimensions at a general, modality independent, level in conveying new knowledge with the help of technology.

The following structural dimensions need to be taken into account for design of a helpful gesture-based human-robot communication in designing pedagogical rehabilitation situations – the embodying dimension and the sign-symbol translation dimension. These dimensions are represented in illustrative ways by the extreme robotic cases of the recently introduced robots Jibo and Pepper, mentioned earlier in the chapter.

Implementing the Embodying Dimension: Jibo and Pepper represent successful realizations of abstract notions in human-robot interaction. The purpose of designing Jibo is to invent a physical structure that can "resonate in a 'socially connected' way" [1], without being anthropomorphic. Designed as the "first home robot", Jibo can stand in any place in the house and socialize in a personalized, individualized way. The physical process of resonance is being mapped on the subjective, empathic process of sharing 'wave-like' internal dynamics.

To achieve the bodiless expression of gestures – curiosity, attentiveness, concern, etc. that is typically called body language in a human – the main implemented component was called "a friendly silhouette activated by an expressive movement" [2]. Jibo is a perfect demonstration that robots can implement social-communication signals beyond the necessity for anthropomorphic physical appearance. Jibo can be placed at the bodiless extreme of the abstract dimension of human presence reinstatement as social resonance (i.e. via gestures or body language). To the other extreme can be placed Pepper, being recently introduced as the "first humanoid robot designed to live with humans" [3], i.e. being also adapted to 'smart homes' and 'ambient assisted living' infrastructures. The main functionality of Pepper is responding to emotions. The responsiveness is based on recognizing, understanding and responding by "body language" and hand gestures being anthropomorphized mainly as human silhouette and gestures of the hands.

The proposed framework uses the respective embodying of gestures according to the pedagogical need of the person with learning difficulties. The robot performs as pedagogical assistant and is being monitored closely by the teacher. Focusing on this dimension will help the learner to acquire social communication competence in an implicit, rather than explicit, way.

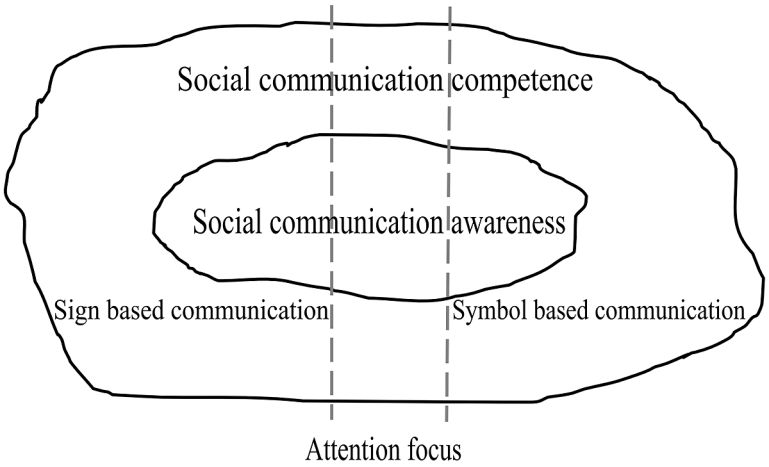
Implementing the Sign-Symbol Dimension: In linguistics the sign-symbol relation is one of the fundamental laws of learning for communication in human society. Both underlie the semantics of the message (i.e. the conveyed meaning), however on different abstract level of its understanding (e.g. T. Dickins, & D. Dickins, 2001). People with learning difficulties may adapt to the sign level of communication (i.e. understanding and conforming to rules) but not understand symbols and their conceptual complexity. Both examples of robot-assistants – Jibo and Pepper – optimize in a different way the sign-symbol transition. For example, Jibo can display a heart to mean "I love you" (sign level of communication), whereas Pepper uses a tablet to prompt the user write or select the request (symbolic level of interaction). Both can display hand sign language – in a virtual or real format of the hand. An interactive technology to support education of children with hearing problems called ITG (interactive technology based on gestures) is proposed and designed in (Krastev, Lekova, Dimitrova, & Chavdarov, 2014). It displays an anatomically realistic robotic hand in either virtual or real form in the format of a learning game of the international sign language. The system provides the reward in the form of scores and cheerful messages. It is proposed in the present chapter to make robots like Jibo capable of translating the verbal communication into sign language and the opposite in order to make the communication between a deaf child and the hearing parents more fluent. In this way personal robots of different communicative abilities will help interact with and assist in developing the learning skills of people with various needs or learning styles. The system can be a useful assistant to the pedagogical process both in the classroom and at home.

FUTURE RESEARCH DIRECTIONS

The approach to design high-level synthetic sensors with social communication competence will be developed further for development of technologically-enhanced educational systems for children with special learning needs. The main elements of the theoretical framework are presented in Figure 4. Social communication competence is considered a broader, neurologically situated process, than social communication awareness. The awareness of one's own communication competence is a psychological process, contained within social communication competence, which includes both implicit and explicit aspects. Towards the implicit end of this dimension is the sign-based communication, which is often implicit. Road signs, for example, enhance implicit processing and fast closing of the perception-action loop, suitable to be understood without words. At the other extreme of the social communication competence dimension is symbol-based communication. Language is considered the most widespread symbolic communication channel, where the explicit cognitive processing is dominating. Tests will establish the current level of social communication competence of the learner. By modulation of the attention focus the aim is to achieve a shift from the sign to the symbol level of understanding of the taught material. The crucial role of the robotic assistant technology is in *capturing* and *cuing* the learner's attention as an external cognitive aid.

The attention process of the learners needs constant attraction, since the cognitive resource of the learner is limited. A socially competent robot like NAO can entertain while capturing and cuing the attention, so that cognitive resource is spared for learning and rehearsing the educational material in a less effortful way (Dimirova et al., 2015). This work is currently underway and will involve experimental data with children with special learning needs or style.

Figure 4. A framework for development of technologically-enhanced educational systems based on implemented social communication competence



CONCLUSION

The chapter presented a conceptual model for high-level synthetic sensor design in present-day Web x.0 mediated socially-competent computing systems towards design of computing systems that are able to operate on the social level of description of a situation by reading the cues in a way similar to people reading social cues. Within the infinite number of possible personality dimensions – those relevant to the current technological situation can be selected from observational data. It is proposed to focus on modeling human behavior in response to attitudes. High level synthetic sensors, reacting to unambiguous sets of data can be designed and implemented in socially competent computing systems to increase their level of intelligence. The possibilities for application of the proposed theoretical approach to education of people with special learning needs or style are briefly discussed. This framework has many applications in lifelogging systems, rehabilitation robotics, social computing and other socially-grounded technology.

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ENDNOTES

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