



EmoSocio: An open access sociometry-enriched Emotional Intelligence model

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ABSTRACT

Significant efforts have been allocated over the last thirty years towards the definition and measurement of the Emotional Intelligence (EI) construct. Several EI theories and models have been produced to support psychological assessment processes. However, barriers are identified for their wide adoption and exploitation by social scientists. The absence of a common structured format to represent concepts in EI models has resulted in lack of clarity and consistency, while hindering comparison, validation and extensive evaluation processes. Provision of open access to such models and measurement instruments has not been promoted so far, however, considered crucial for their wide adoption. Furthermore, the inclusion of indexes from the sociometry domain can facilitate participatory modeling by multidisciplinary scientists during the development of social and emotional training programs. To address these challenges, we propose EmoSocio, an open access Emotional Intelligence Model, built upon a detailed comparison and synthesis of the main constructs represented in widely accepted EI models and enriched with sociometric indexes at an individual and group level. Upon detailing the methodological approach followed for the development of the EmoSocio model, we present the EI and social constructs of the model, followed by an assessment of the EI part in terms of reliability and validity. EmoSocio is also represented in a semantically-enriched format in the form of an ontology. Our ambition is to provide an open access EI model that can be used by multidisciplinary scientists to evaluate psychological assessment processes and develop interventions, aiming to strengthen interpersonal and intrapersonal competencies.

1. Introduction

Emotional Intelligence (EI) is one of the most highly used psychological terms by multidisciplinary scientists the last three decades, focusing on its applicability on research and applied fields to tackle societal challenges at intrapersonal and interpersonal level. As defined by Salovey and Mayer, EI is “a type of social intelligence that involves the ability to monitor one’s own and others’ emotions, to discriminate among them, and to use the information to guide one’s thinking and actions” (Mayer and Salovey, 1993). EI is also used to manage and/or adjust emotions to adapt to environments or achieve one’s goal(s) (Colman, 2009). High EI is associated with positive effects -among others- on mental health (Fernández-Abascal and Martín-Díaz, 2015), stress management (Lea et al., 2019), aggressive behavior (García-Sancho et al., 2014), leadership skills (Rosete and Ciarrochi, 2005), academic (Qualter et al., 2007) and job performance (Sy et al., 2006).

A lot of research effort has been devoted towards the definition and measurement of the EI construct. Several EI theories and models have been developed to support psychological assessment processes. However, a set of barriers are identified that do not permit the homogeneous

representation and evaluation of the EI construct, as well the wide adoption and usage of the produced measurement instruments by multidisciplinary scientists to tackle emerging societal challenges. Following, we shortly present these challenges, along with the motivation and main contribution of our work in this article.

1.1. Challenges

The validity of the EI construct has been contentiously debated, since existing approaches consider EI from different perspectives and there is a lack of clarity on how EI should be defined and/or appropriately measured (Qualter et al., 2007; Hogeveen et al., 2016; Zeidner et al., 2008; O’Connor et al., 2019; Petrides, 2011). Conceptually distinct forms of EI have emerged, classified as “ability EI”, “trait EI” and “mixed model EI”, while various psychometric instruments are developed to measure these forms (O’Connor et al., 2019). Such EI measurement instruments vary widely in both their content and their method of assessment, since their developers have been based on different definitions of the EI construct, which has resulted in different types for the various measures (Conte, 2005; Gowing, 2001). It can be claimed that there is a strong

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need for a consistent, expressive and less ambiguous representation of the concepts denoted in EI models to allow high adoption, comparison, integration and further development by interdisciplinary scientists. Areas of overlap and difference among existing EI models have to be identified, leading to the composition of models that include the already defined key constructs, while in parallel reducing the ontological misalignment among them. In this way, the scientific community will be able to compare theories in terms of their content and to promote the usage of common representations and measurement instruments.

Furthermore, open access to EI models and measurement instruments regards a strong prerequisite for their wide adoption. Open science principles have to be adopted, making the produced knowledge transparent and accessible to scientists through collaborative networks. Currently, most of the existing EI measurement instruments regard proprietary and copyrighted solutions, non-openly available to the community (O'Connor et al., 2019). This limits the potential for extensive evaluation, further development and refinement of EI models from multiple and multidisciplinary research teams. Open usage of EI measurement instruments can boost the realization of EI assessment studies, facilitating the validation and revision of the proposed models. Towards this direction, the International Personality Item Pool (IPIP) [(International Personality Item Pool (IPIP) 2020; Goldberg et al., 2006)] is intended as an international effort to develop and continually refine a set of traits, whose items are in the public domain, and whose scales can be openly used for both scientific and commercial purposes.

The blending of EI constructs with sociometric and social network analysis (SNA) indexes is also considered beneficial for strengthening the social intelligence part. EI models include concepts related with empathy, assertiveness, leadership, ability for managing relationships and conflict resolution (O'Connor et al., 2019). Such concepts are evaluated in cases where socioemotional interventions are applied at individual or group level. However, these concepts per se, are disjoint with the dynamics of the social environment where the intervention is taking place. To monitor and evaluate social interactions within a specific social environment, sociometric assessment and SNA techniques offer a variety of methods for identifying group dynamics (e.g., group cohesion, number of cliques, centrality measures). Sociometry, as a standalone scientific domain, provides a snapshot of a social group dynamics but fails to reveal the individuals' emotional subjective experiences of group relationships. Blending of both emotional and social constructs and including group dynamics representation indexes within an EI model can boost social scientists to develop and evaluate socioemotional interventions in various contexts (e.g., social and emotional training), considering the social environment where the interventions are taking place.

1.2. Motivation

The core motivation for the work presented in this article stems from the need to tackle the aforementioned challenges. We aim to provide an open access EI model -in the following we refer to this model as EmoSocio- for representing emotional and social traits, along with an open access measurement instrument, called from now on as EmoSocio Inventory, that can be jointly and freely used by social scientists. EmoSocio aims to reduce the overlapping terminology and bridge ontological differences of existing EI models through the composition of EI constructs that are highly represented in well-known and reliable EI models. It integrates sociometric indexes, aiming to capture the social environment dynamics where socioemotional assessment processes take place. It opts for a semantically enriched format, in the form of an ontology, to facilitate its transparent interpretation and ease adoption from third party professionals, while it is open in terms of usage under a Creative Commons Public License. Compared to existing EI models, EmoSocio has the advantage of being open, transparent and self-explainable.

EmoSocio revises constructs from trait EI, ability EI and mixed EI models. It is noted that the largest part of the research in the EI domain is realized within the broader domain of trait EI (Petrides et al., 2016;

Chirumbolo et al., 2019), where self-reporting is used. Under this perspective, we have modeled EmoSocio as a trait EI model as the most representative approach, following existing work on the specification of trait EI models (Petrides, 2011). Within EmoSocio, emphasis is placed on (social and emotional) personality traits that represent EI constructs. To support valid and reliable self-reporting EI assessment, a set of scales for emotional and social competences are defined, taking advantage of the multiple items and scales made available within the IPIP scientific collaboration (International Personality Item Pool (IPIP) 2020). A primary evaluation of the validity and reliability of EmoSocio is made available, based on an assessment study with 153 participants.

2. Material and methods

2.1. Methodological approach and material

In this section, we detail the methodological approach that we followed for the development of the EmoSocio EI model and inventory. We have considered methodological approaches followed on relevant studies, where various phases including the literature review part, the specification of theoretical models, the design of pilot studies and the assessment part are defined (Fernández-Abascal and Martín-Díaz, 2015; O'Connor et al., 2019; Chirumbolo et al., 2019; Schutte et al., 1998; West et al., 2019; J. Abbas et al., 2019; J. Abbas et al., 2019). The overall methodology followed is depicted in Fig. 1.

Given the objective to conceptualize an expressive EI model that considers overlapping of constructs in existing models and aims to be less ambiguous, we initially came up with a set of terminology definitions (step 1) that are consistently used in the EmoSocio model description. The proposed terminology is in accordance with the terminology used in the dominant EI models and is shortly detailed in Section 2.4. Following, effort was given on the specification of the EmoSocio constructs, covering both the emotional and the social part of the model.

In the emotional part of EmoSocio, upon examining detailed reviews of existing EI theories (step 2) that consider the construct of EI from different perspectives, we came up with the selection of six EI models that have a dominant presence in the literature in terms of publications and strong empirical basis. Next, we compared the constructs definition in the selected EI models, we semantically aligned them to reduce existing ontological differences and examined their overlapping (step 3). Based on the outcomes of this step, we filtered the listed constructs to reduce their dimensionality, while keeping the most significant ones. The filtering criteria were based on the popularity of the denoted constructs. We actually kept the constructs that were presented in more than half of the selected theories, leading to the composition of EmoSocio with twelve EI constructs (step 4).

Subsequently, we defined the scales (step 5) for the measurement of the EmoSocio constructs, taking advantage of IPIP. IPIP has been conceived as a resource for personality assessment professionals, aiming to provide rapid access to measures of individual differences, all in the public domain, to be developed conjointly among scientists worldwide (International Personality Item Pool (IPIP) 2020). It includes over 3000 items and over 250 scales that have been constructed from the items (International Personality Item Pool (IPIP) 2020). We initially mapped the EmoSocio constructs with existing IPIP constructs present at the IPIP repository. Most of the EmoSocio constructs are composed from more than one IPIP construct, while each IPIP construct is measured by one or more IPIP scales. Focus was given on the validity and reliability of the selected scales, given that unreliable scales prevent the consistent measurement of variables, while scales low in validity may not measure appropriately the intended variables (Robinson, 2018). IPIP offers scales that present high reliability and validity since they have both high Cronbach's alpha coefficients and high and statistically significant correlation with the original scales that they were built upon.

Moving one step further, each IPIP scale is associated with a set of IPIP items. For the set of IPIP scales associated with an IPIP construct, we

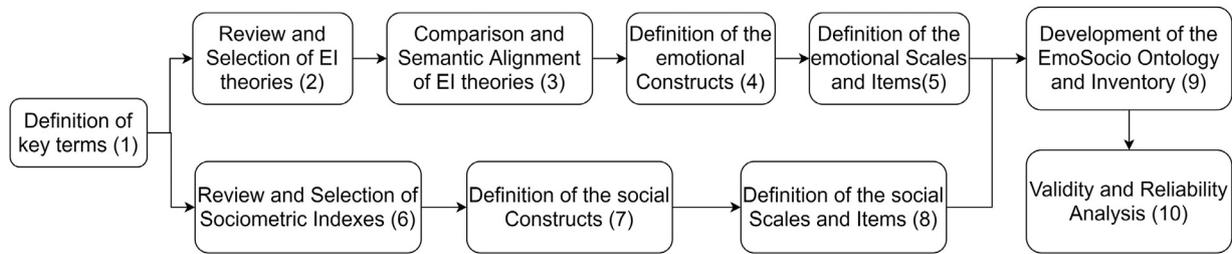


Fig. 1. EmoSocio Model development methodology.

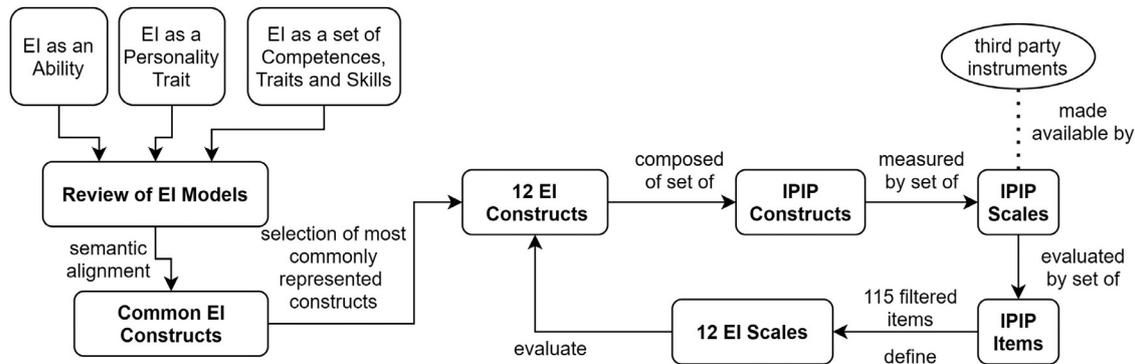


Fig. 2. Process for composition of the emotional part of the EmoSocio Model.

collected all the available IPIP items and we reduced them by removing duplicates, those with alpha coefficients lower than 0.70, semantic repetitions or deviations. Per EI EmoSocio construct, we concluded with 6–14 items. The final set of items per EI EmoSocio construct composes the EI EmoSocio scale. The provided response per item is evaluated based on a Likert scale with values ranging from 1 (Very Inaccurate) to 5 (Very Accurate). Once rating is assigned in all the items of a scale, the average rating value is considered as the total score of the scale. In this way, the twelve EI EmoSocio constructs are converted to twelve EI EmoSocio scales, each one of them associated with reliable and valid IPIP items. In total, the twelve EI EmoSocio scales are mapped to 115 IPIP items. The aforementioned process for the composition of the emotional part of EmoSocio is depicted in Fig. 2.

In the social part of Emosocio, a similar process has been followed for the definition of the social constructs of the model (Fig. 3). These constructs are composed based on sociometric indexes, as they are made available in the literature. Initially, we reviewed the literature for sociometric assessment processes (step 6) that include specific direct and compound indexes (e.g., popularity coefficient, affective connection) as well as for social network analysis algorithms (step 6) that calculate specific individual and group metrics (e.g., group cohesion), considering also our previous work on the field (Fotopoulou et al., 2019; Fotopoulou et al., 2021). Based on the provided outcomes of these steps, we selected the most widely-used metrics, resulting in ten constructs (step 7). Per construct, we also documented the scales used to measure it. Each scale is based on a sociometric formula or an equation associated with an SNA algorithm (step 8). It should be noted that for part of the social scales, multiple algorithms have been used for their measurement, taking advantage of existing SNA techniques. The input data is provided based on four items that capture the group dynamics related to the individuals' preferences, rejections, perceptions of preferences and perception of rejections within a social group.

By having concluded on the basic constructs for the emotional and the social part of the EmoSocio model, along with the definition of the associated scales and items of the EmoSocio inventory, we considered helpful to map this knowledge under a formal representation in the form of an ontology (step 9). A formal representation helps to improve clarity

and consistency of the denoted constructs, facilitating their adoption, revision, interlinking and extension by the scientific community. The description of the EmoSocio ontology is based on the W3C Web Ontology Language (OWL). In parallel, we have created the EmoSocio Inventory (step 9) that consists of the set of 115 items (available in the Appendix), covering both emotional and social aspects.

Finally, to evaluate the validity and reliability of the emotional part of the EmoSocio model, we have realized an assessment study over data collected by 153 participants (step 10). Focus is given on producing primary evaluation results that can accompany the theoretical specification of the model. The analysis scripts are developed in Python, while part of the statistical analysis is done with the open-source software Jasp.

2.2. Participants

The assessment was based on the collection of data from 153 participants, having their origin in a variety of countries across Europe, while belonging to a set of professional domains (clustered in three categories of social, technical and financial sciences), age groups (from 17 to 63 years old) and gender (54% were women and 46% were men). The average age of participants was 33.8 with standard deviation 8.95. The participants provided their consent and voluntarily collaborated with the study without receiving any financial compensation.

The participants rated themselves on each of the 115 items of the emotional part of the EmoSocio model, using a five-point response scale. In addition, a number of participants also filled out further established measurement instruments associated with other EI models for analysis purposes. Specifically, 20 out of the 153 participants completed the short form of the IPIP-NEO Questionnaire that is composed by 120 items (The IPIP-NEO 2020; Johnson, 2014) and assesses a person's Big Five personality traits, the Self-Report Emotional Intelligence Test (Schutte et al., 1998) that assesses the emotional intelligence as defined by Salovey and Mayer (Mayer and Salovey, 1993) and the short version of the TEIQue Questionnaire (Petrides, 2011).

Based on the collected results, validity and reliability analysis for the EmoSocio model has been realized, including the examination of the correlation of EI constructs of the EmoSocio model with relevant constructs in well-known EI models.

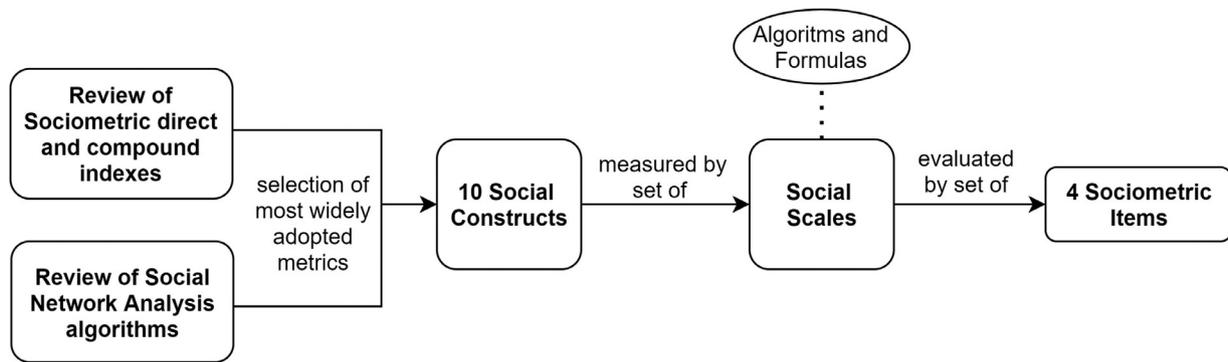


Fig. 3. Process for composition of the social part of the EmoSocio Model.

2.3. Open data

The provided work and material in this manuscript is made openly available to be accessible, discoverable and usable by the scientific community. The EmoSocio model and inventory are detailed, including the description of the constructs and the definition of the set of items and the associated scales. The EmoSocio Ontology is also made publicly available, facilitating its adoption, usage and extension by interested parties (The EmoSocio Ontology Specification 2020). The data collected by the participants through the questionnaires are anonymized and made available as open data, while the analysis results are detailed in this manuscript and can be easily reproduced (Fotopoulou et al., 2020).

2.4. Definition of key terms

In this section, we provide a short definition of the key terms used throughout the manuscript for the description of the EmoSocio model, considering existing definitions and terms used widely in the bibliography for the description of relevant models.

The term “theory” and “model” have been defined in many ways. The definitions of the two terms can be confusing and their differences are often not clear enough. For the term “theory”, one definition agreed by a multidisciplinary panel of experts from psychology, sociology, anthropology and economics is “a set of concepts and/or statements which specify how phenomena relate to each other, providing an organizing description of a system that accounts for what is known, and explains and predicts phenomena” (West et al., 2019; Davis et al., 2015). According to the American Psychological Association (APA) (APA Dictionary of Psychology 2020), a model can be seen as a “theory, usually including a mechanism for predicting psychological outcomes, intended to explain specific psychological processes”. It is also defined as “a representation of human cognitive and response characteristics used to approximate and evaluate the performance of an actual individual in a complex situation” (APA Dictionary of Psychology 2020).

Simply put together, both EI theories and models state possibilities and provide explanations for individual and group emotional phenomena. In the current manuscript, we approach the term model as a physical representation or an application of a theory. Since our ambition is to come up with a quantitative representation of the EI and social profile of individuals, EmoSocio is defined as a model. The EmoSocio model is composed of constructs, considering that constructs, concepts, facets or dimensions are equivalent terms used frequently from EI theories in an interchangeable way. According to APA, a construct can be defined as a complex idea or concept formed from a synthesis of simpler ideas, used to organize information and to integrate it into one’s general knowledge (APA Dictionary of Psychology 2020). For the sake of simplicity, we have adopted the term construct all over the current manuscript. EI -apart from being a construct itself- is composed from a set of constructs (e.g., empathy, self-awareness).

As already mentioned in Section 2.1, constructs are converted to specific scales in order to be measured through a set of items. The term “item” refers to an individual question or statement that respondents are meant to reply. The term “scale” refers to a collection of items intended to measure the same construct, where the items almost always have the same response format (e.g., a set of selection options that are measured from 1 to 5). The collection of items composes the EmoSocio Inventory. The overall scoring of the EmoSocio Inventory evaluates an individual’s EI and social traits with respect to the defined EmoSocio constructs and the associated scales.

3. Theory

3.1. Emotional intelligence theories classification

Emotional Intelligence (EI) has been conceptualized under distinct forms the last three decades, mainly under the categories of ability EI, trait EI and mixed EI (O’Connor et al., 2019). A distinction between ability EI and trait EI has been provided by Petrides based on the applied measure (Petrides and Furnham, 2001). In the case of ability EI, the measure was a test of maximal performance, while in the case of trait EI, a self-report questionnaire is being used. Another method of classification is in the form of EI streams, where stream 1 refers to ability measures, stream 2 to self-report measures and stream 3 to self-report mixed measures (O’Connor et al., 2019). The latter ones measure a combination of traits, social skills and competencies that overlap with other personality measures and belong to the category of mixed EI. Most of the mixed EI measures consider the assessment of emotional competencies of individuals that are mainly used for improving their professional capabilities (Goleman, 1995). However, considering the distinction provided by Petrides, stream 2 and stream 3 measures are both classified as trait EI measures. Furthermore, independently of the type of the stream, self-report measures present high correlation among each other (Pérez et al., 2005).

Considering the aforementioned classification of EI theories, we have selected and examined six EI models that are considered dominant in the area of EI based on their strong presence in the literature -depicting adoption levels and usage- and their assessment based on a strong empirical basis. The selected models are representative of ability EI, trait EI and mixed EI models, while various overlaps exist in the declared constructs. Following, we shortly refer to these models, taking into account their category and that they consider EI as a set of abilities, personality traits, competencies, or a combination of them. The selected models cover a wide range of application domains, including, for instance, work environments (e.g., the model proposed by Goleman (Boyatzis et al., 2000)) and educational environments (e.g., the model proposed by Bisquerra and Perez (Bisquerra Alzina and Perez Escoda, 2007)).

EI emerged as a psychological construct in the early 1990s, where Salovey and Mayer (model 1 - ability EI) have conceptualized it as a set of abilities that are analogous to general intelligence (Mayer and

Salovey, 1993; Mayer et al., 2016). A relevant definition of EI was produced, as detailed in the introductory part of the manuscript. Individuals with high EI are considered to have certain emotional abilities and skills to appraise and regulate emotions in the self and others (O'Connor et al., 2019). The model has been slightly revised in 2016, where EI has been positioned amidst other hot intelligences including personal and social intelligences (Mayer et al., 2016). The four branches refer to “perceiving emotion”, “facilitating thought using emotion”, “understanding emotions” and “managing emotions”. Assessment is based on the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) that involves scoring against results determined by a panel of experts, as well as results obtained using the Self-reporting of Emotional Intelligence (SREI).

Goleman broadened Mayer and Salovey’s four-branch system to incorporate five essential elements of emotional intelligence: emotional self-awareness, self-regulation, motivation, empathy and social skills (Boyatzis et al., 2000). The overall EI model (model 2 - mixed EI) includes four main domains, namely self-awareness, self-management, social awareness, and relationship management. Within these domains, twelve EI competencies are nested. The EI model is assessed by the emotional and social competency inventory (ESCI) (Emotional and social competence inventory (ESCI) 2020). The ESCI measures the demonstration of individuals’ behaviors, through their perceptions and those of their raters, making it distinct from measures of EI that assess ability or personality preferences.

The Bisquerra and Perez’s (Bisquerra Alzina and Perez Escoda, 2007) (model 3 - trait EI) theoretical model of emotional competence proposes that emotional competencies can be grouped into five big dimensions: emotional awareness, emotional regulation, personal autonomy, social competence, and life competencies and well-being. The Bisquerra and Perez’s model can be considered a trait EI model because it incorporates both cognitive and personality dimensions. Assessment is based on the Emotional Development Inventory for Adults that is a self-report instrument (Bisquerra Alzina and Perez Escoda, 2007).

In the Bar-On model of emotional-social intelligence (ESI) (Bar-On, 2006) (model 4 - Mixed EI), emotional-social intelligence is considered as a cross-section of interrelated emotional and social competencies, skills and facilitators that determine how effectively we understand and express ourselves, understand others and relate with them, and cope with daily demands (Bar-On, 2006). The Bar-On model considers five main constructs, related to the intrapersonal ability to be aware of oneself, the interpersonal ability to be aware of others’ emotions and to establish qualitative relationships, stress management competencies, effective management and adaptivity to changes, and trend to be sufficiently optimistic, positive and self-motivated. The Bar-On model provides the theoretical basis for the Emotional Quotient Inventory (the EQ-i) that is a self-report measure of emotionally and socially intelligent behavior that provides an estimate of emotional-social intelligence (Bar-On, 2006).

The trait EI model provided by Petrides (Petrides, 2011; Petrides et al., 2016) (model 5 - trait EI) is a theoretical framework that integrates emotions, personality traits, and intelligence, broadly defined. It is defined as a constellation of emotional self-perceptions located at the lower levels of personality hierarchies and measured via the trait emotional intelligence questionnaire. The trait EI model includes 15 facets, which are grouped into four broad factors. These facets are personality traits, as opposed to competencies or mental abilities or facilitators in other models. The four broad factors are self-control, emotionality, sociability and well-being.

The Five-factor model (FFM, known also as Big Five) (model 6 - trait EI) consists of five broad factors (dimensions) of personality traits (Goldberg, 1990). These factors regard the extraversion (includes traits as talkative, energetic, and assertive), the agreeableness (includes traits like sympathetic, kind, and affectionate), the conscientiousness, the neuroticism (includes traits like tense, moody, and anxious) and the openness to experience (includes traits like having wide interests, being imaginative and insightful). The FFM structure was derived from statisti-

Table 1
EI Models Core Constructs/Dimensions and Type.

EI Model	Constructs/Dimensions	Type
The Ability Model of Emotional Intelligence (Salovey, Mayer and Caruso) (Mayer et al., 2016)	Perceiving emotion, Facilitating thought using emotion, Understanding emotions, Managing emotions	Ability EI
Emotional and Social Intelligence (Goleman and Boyatzis) (Boyatzis et al., 2000)	Self-awareness, Self-management, Social awareness, Relationship management	Mixed EI
Emotional Competences (Bisquerra) (Bisquerra Alzina and Perez Escoda, 2007)	Emotional consciousness, Emotional regulation, Emotional autonomy, Social competence, Well-being	Trait EI
The EI Competencies and Skills (Bar-On) (Bar-On, 2006)	Intrapersonal, Interpersonal, Stress Management, Adaptability, General Mood	Mixed EI
EI Trait in adults (Petrides) (Petrides, 2011; Petrides et al., 2016)	Well-being, Self-control, Emotionality, Sociability	Trait EI
Five Factor Model (Goldberg, 1990)	Openness to Experience, Extraversion, Agreeableness, Conscientiousness, Neuroticism	Trait EI

cal analyses of the traits that tend to co-occur in people’s descriptions of themselves or other people. The Revised NEO Personality Inventory (NEO PI-R) is a personality inventory that examines a person’s FFM personality traits and reports on six subcategories of each personality trait. IPIP-NEO-120 (The IPIP-NEO 2020) is an IPIP version of the NEO-PI-R test.

By reviewing these models it can be observed that, independently of the category of EI, a set of similarities and conceptual overlaps appear in the majority of the models and measures, including the considered constructs and their breakdown in multiple facets. In particular, following the classification for EI constructs that was initially proposed by Mayer and Salovey (Mayer et al., 2016), the majority of measures include facets related to perceiving emotions (in self and others), regulating emotions (in self and others) and utilizing emotions. Furthermore, EI constructs are represented in the form of abilities in the model by Salovey and Mayer that is the most widely accepted ability model, as a set of micro-competencies in the models of Goleman, Bar-on and Bisquerra, and as a set of personality traits in the models of Petrides and the Five factor model. Table 1 summarizes the selected EI models along with their core represented dimensions and their classification based on the EI assessment category that they belong to.

3.2. Emotional intelligence part of the EmoSocio model

3.2.1. Emotional intelligence constructs

In this section, we present the outcomes of the revision of the selected six EI models that results in the selection of the EI constructs of the EmoSocio model. The revision process included the detailed examination of the semantics of each of the defined constructs in the existing models, along with their semantic alignment and clustering. Constructs representing the same concept under slightly different terminology or by using synonyms are clustered under a unified construct. Special care was given to come up with a model that can be highly representative in terms of consideration of EI facets, while not excluding existing core facets. On the other hand, peripheral facets that appear in only one model were excluded to reduce complexity and avoid overloading of the denoted terms.

To simply represent the clustered EI constructs, we have classified them in two categories as intrapersonal or interpersonal. We consider that it is better to keep a simple classification among the constructs and not create various sub-constructs with the risk of having overlapping concepts, hindering the self-explainability of the produced model. The

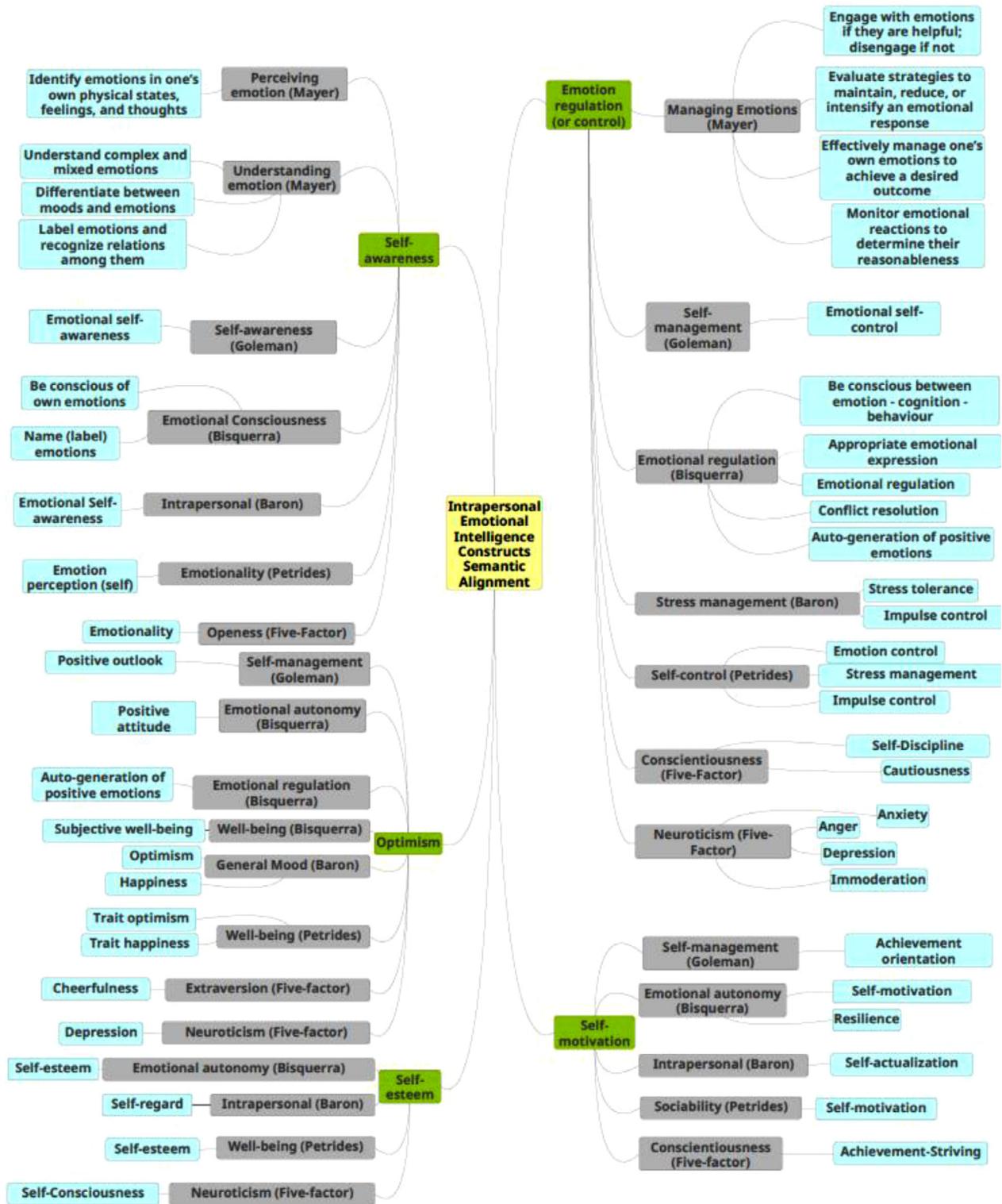


Fig. 4. Semantic Alignment of EmoSocio Intrapersonal Emotional Intelligence Constructs.

intrapersonal skills refer to something taking place within one individual, helping oneself to recognize his own strengths and weaknesses (e.g., understand oneself, appreciate one’s feelings, fears and motivations). The interpersonal skills refer to something taking place between people, helping someone to understand, collaborate and work with others (e.g., understand the intentions, motivations and desires of other people). In Fig. 4 and Fig. 5, we present the results of the semantic alignment and clustering process for the intrapersonal and the interpersonal category respectively. In each case, the clustered construct is broken down into

a set of sub-constructs, as derived from the review of the six EI models. The short name of each construct along with the model where it is represented is detailed. We have included the constructs that are present in at least four of the six considered EI models. Given the existing overlapping among constructs, this led to the mapping of a high percentage of existing constructs (including abilities, traits, competences, skills) to the clustered constructs.

Based on the outcome of the clustering process, we have ended up with the formal definition of twelve emotional constructs in the EmoSo-

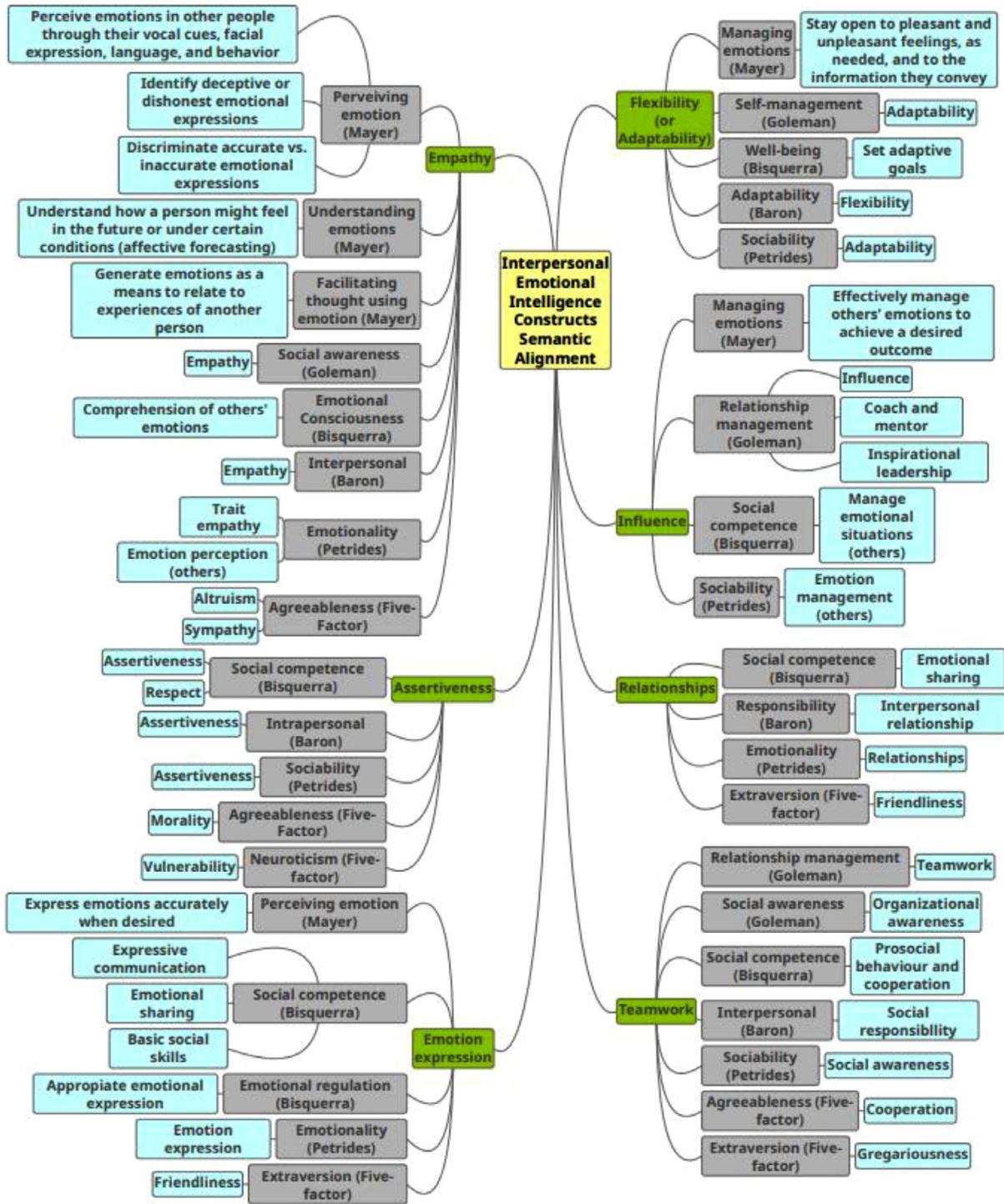


Fig. 5. Semantic Alignment of EmoSocio Interpersonal Emotional Intelligence Constructs.

cio model. As already mentioned, each construct is composed of a set of common or highly relevant constructs in the existing models. Each construct is classified as intrapersonal or interpersonal. The EmoSocio model constructs are summarized in Fig. 6, where the number besides each construct denotes the presence of the construct in the aforementioned six EI models.

In Table 2 we provide the definitions of the EmoSocio emotional constructs. Each definition has been derived considering existing definitions in the selected six EI models, as well as definitions provided by APA.

3.2.2. Emotional intelligence constructs' scales and items

Following, we have defined the relevant scale per construct, based on the methodological approach detailed in Section 2.1. As noted, we initially mapped the EmoSocio constructs with existing constructs at the IPIP repository, considering their semantic similarity. Given that each EmoSocio construct is composed from more than one IPIP construct, each scale per EmoSocio construct is also associated with a set of IPIP scales. Each IPIP scale is measured by a measurement instrument made available within the IPIP Scientific Collaboratory (Multi-Construct IPIP Inventories 2020).

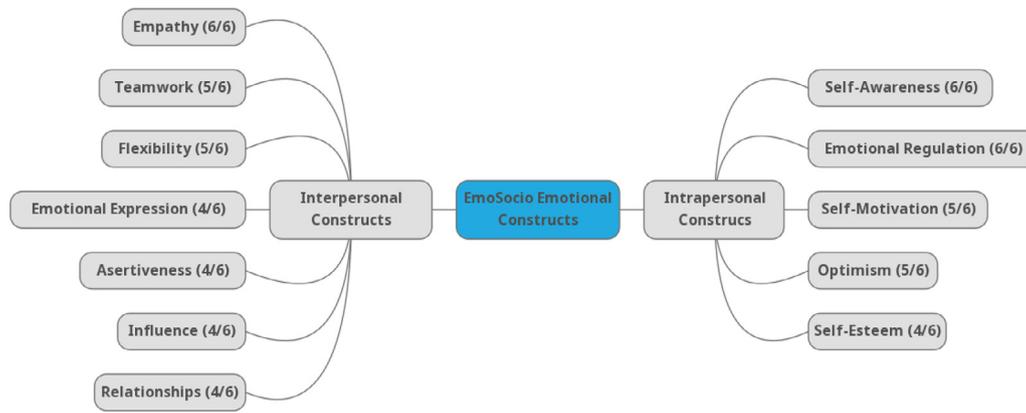


Fig. 6. The EmoSocio Emotional Constructs.

Table 2
EmoSocio Emotional Constructs Definition.

Category	Construct	Definition
Intrapersonal	Self-Awareness	Understand our own emotions and the effects they have on us.
Intrapersonal	Emotional Regulation	Modulate an emotion or set of emotions (e.g., manage the intensity or duration, change the target of an emotion towards a more positive outcome) and maintain our effectiveness under stressful conditions.
Intrapersonal	Self-Motivation	The impetus that gives purpose or direction to behavior and operates in humans at a conscious or unconscious level. The tendency to be determined and persevering with a strong sense of achievement and low possibility to give up in the face of adversity.
Intrapersonal	Optimism	The anticipation of positive outcomes and things to happen in life, whether serendipitously or through perseverance and effort, and the confidence for achievement of the desired goals.
Intrapersonal	Self-Esteem	The degree to which the qualities and characteristics contained in one's self-concept are perceived to be positive. It reflects a person's physical self-image, view of his or her accomplishments and capabilities, and values and perceived success in living up to them.
Interpersonal	Empathy	Sense others' feelings, needs and perspectives, taking an active interest in their concerns and picking up cues to what is being felt and thought.
Interpersonal	Teamwork	Work with others towards a shared goal, participating actively, sharing responsibility and rewards. The ability to read a group's emotional currents and power relationships, identifying influencers, networks and dynamics.
Interpersonal	Flexibility	Modify or adjust one's behavior in meeting different circumstances or different people. The ability to adapt to new environments and conditions.
Interpersonal	Emotional Expression	Communicate our emotions to others and express accurately and unambiguously our feelings.
Interpersonal	Assertiveness	An adaptive style of communication in which individuals express their feelings and needs directly, while maintaining respect for others. The ability to stand up for their rights and beliefs.
Interpersonal	Influence	Effectively manage others' emotions to achieve a desired outcome and/or change their behavior or attitude.
Interpersonal	Relationships	Start and maintain emotional bonds with others, establish mutually satisfying relationships and relate well with others.

In Table 3, we present the set of IPIP scales that compose a scale of each EmoSocio construct. Per EmoSocio construct, we detail the relevant IPIP constructs, the total number of available scales for measuring these IPIP constructs, the number of associated items along with their measurement instruments and their existing Cronbach's alpha coefficients, as well as the number of the selected items for inclusion in the EmoSocio inventory. It should be clarified that the provided Cronbach's alpha coefficients refer to the existing scales within IPIP. The Cronbach's alpha coefficients for the EmoSocio emotional constructs are assessed and detailed in Section 4. Furthermore, the selected list of items per EmoSocio construct is made available at the Appendix, where all the times of the EmoSocio Inventory are presented. The list was produced upon filtering and processing of the initial items to reduce their dimensionality, while in parallel maintaining items that can holistically express the semantics of each EmoSocio construct.

3.3. Sociometry and social network analysis theories

The building and evolution of social relationships and interactions are considered important for the social development of individuals. Sociometry and social network analysis (SNA) are two research areas that have been developed in parallel and focus on how social dynamics are formulated and evolved within a social group, as well as how these dynamics define the social status of individuals.

Sociometry theory has been introduced by Moreno to facilitate constructive change in individuals and groups through the scientific measurement of social relationships (Darity and Mielants, 2007; American Society of Group Psychotherapy, and Psychodrama 2020). It is considered as a methodology for tracking the energy vectors of interpersonal relationships in a group (Hoffman, 2001). As stated by Moreno, sociometry measures the "socius" that regards the interpersonal connection between two people (Darity and Mielants, 2007; Moreno, 1951). The individual is examined based on its relationship with others, considering both short- and long-term relationships and their evolution across time. By acquiring a complete understanding of the social structure of a group, it can lead to interventions aiming to reduce conflicts, increase group cohesion and productivity (Darity and Mielants, 2007; Moreno, 1951). The outcome of a sociometric assessment process is represented through a sociogram.

Complementary to sociometry theory, social network analysis (SNA) focuses on assessing the broader structural pattern of social relationships in a particular setting, through the use of networks and graph theory (Neal, 2020; Clifton and Webster, 2017). SNA is ideally suited for social-personality psychology because it integrates individuals and the relationships among them (Moreno, 1951). It makes the social structure visible by quantifying the relationships among people as emergent properties of the network (Clifton and Webster, 2017). In this way, it can help to better understand the individual differences and behaviors within a

Table 3
IPIP scales and items per EmoSocio Construct.

EmoSocio Construct/Scale	IPIP Scales	# of IPIP Scales / # of IPIP Items / Alpha Coefficient / # of EmoSocio Items	IPIP Measurement Instrument: Associated Scale (Alphabetical Index of 274 Labels for 463 IPIP Scales 2020)
Self-awareness	Introspection/Private Self-Consciousness, Attention to Emotions, Emotionality	IPIP Scales: 6 IPIP Items: 58 IPIP Alpha: 0.76–0.83 EmoSocio Items: 10	(Private Self-Consciousness: Buss, 1980), (AB5C: V+/I-), (HPI: Self Focus HIC), (Barchard, 2001), (NEO: O3), (16PF: Q4)
Empathy	Empathy, Altruism, Tolerance, Social/Personal/Emotional Intelligence, Emotionality, Compassion	IPIP Scales: 15 IPIP Items: 148 IPIP Alpha: 0.69–0.80 EmoSocio Items: 10	(NEO: A3), (ORVIS: Altruism), (CPI: To), (TCI: C1), (JPI: Tol), (IPIP-IPC: Unassuming-Ingenuous), (VIA: Soc), (NEO: O3), (16PF: Q4), (TCI: C1), (BFAS: Compassion)
Emotional Regulation	Self-regulation, Self-control, Impulse-control, Anxiety, Anger, Behavioral Inhibition/Activation System	IPIP Scales: 16 IPIP Items: 143 IPIP Alpha: 0.71–0.89 EmoSocio Items: 14	(CPI: Sc), (VIA: Se1), (AB5C: IV+/I-), (TCI: S5), (HPI: Impulse Control HIC), (CAT-PD: Anxiousness), (NEO: N1), (JPI: Axy), (16PF: O), (HEX: E-Anxi), (BIS-Anxiety: Carver & White, 1994), (BFAS: Withdrawal), (CAT-PD: Anger), (NEO: N2), (CAT-PD: Anger), (BFAS: Volatility), (BIS/BAS: Carver & White, 1994)
Flexibility	Flexibility, Adaptability	IPIP Scales: 2 IPIP Items: 18 IPIP Alpha: 0.67–0.73 EmoSocio Items: 6	(HEX: A-Flex), (6FPQ: AG3)
Influence	Leadership, Machiavellianism, Social-Confidence	IPIP Scales: 10 IPIP Items: 86 IPIP Alpha: 0.78–0.87 EmoSocio Items: 8	(AB5C: I+/V+), (HPI: Amb), (6FPQ: EX2), (VIA: Lea), (HPI: Leadership HIC), (ORVIS: Leadership HIC), (JPI: Sas)
Optimism	Optimism, Hope, Joyfulness	IPIP Scales: 4 IPIP Items: 39 IPIP Alpha: 0.71–0.86 EmoSocio Items: 10	(CPI: Wb), (TCI: S2), (Scheier, et al. 1994), (VIA: Hop), (MPQ: WB)
Emotion Expression	Emotional Detachment, Expressiveness, Positive / Negative Expressivity, Friendliness	IPIP Scales: 11 IPIP Items: 112 IPIP Alpha: 0.74–0.84 EmoSocio Items: 10	(CAT-PD: Emotional Detachment), (HEX: X-Expr), (Barchard, 2001), (AB5C: I+/II+), (NEO: E1), (16PF: H), (HPI: Lik), (TCI: RD2), (MPQ: SC), (HPI: Likes People HIC), (BFAS: Politeness)
Assertiveness	Assertiveness, Self-confidence, Anxiety, Cooperation, Submissiveness, Dominance	IPIP Scales: 15 IPIP Items: 150 IPIP Alpha: 0.74–0.84 EmoSocio Items: 10	(AB5C: I+/III+), (NEO: E3, A4), (CPI: Do), (16PF: E,O), (MPQ: SP), (BFAS: Assertiveness), (HPI: Self-Confidence HIC), (CPI: To), (TCI: C1), (JPI: Tol), (IPIP-IPC: Unassuming-Ingenuous), (CAT-PD: Domineering), (CPI: Nar), (IPIP-IPC: Assured-Dominant)
Self-motivation	Achievement-Striving, Activity-Level	IPIP Scales: 7 IPIP Items: 6 IPIP Alpha: 0.70–0.82 EmoSocio Items: 10	(NEO: E4), (JPI: En1), (NEO: C4), (TCI: P3), (MPQ: AC), (6FPQ: IT1), (HPI: Competitive HIC)
Relationships	Social Intelligence, Social Withdrawal, Irresponsibility, Responsibility, Distrust, Friendliness, Social-discomfort, Capacity for Love	IPIP Scales: 14 IPIP Items: 139 IPIP Alpha: 0.70–0.87 EmoSocio Items: 12	(VIA: Soc), (CAT-PD: Social Withdrawal), (CAT-PD: Irresponsibility), (CPI: Re), (JPI: Rsy), (MPQ: AL), (16PF: L), (AB5C: I+/II+), (NEO: E1), (16PF: H), (HPI: Lik), (TCI: RD2), (MPQ: SC), (HPI: Likes People HIC), (TCI: HA3), (VIA: Cap)
Self - esteem	Self-esteem, Social-confidence, Satisfaction, Self-deception, Self-acceptance	IPIP Scales: 8 IPIP Items: 66 IPIP Alpha: 0.69–0.84 EmoSocio Items: 11	(Self-Esteem: Rosenberg, 1965) (JPI: Scf), (HPI: No Social Anxiety HIC), (HPI: Self-Confidence HIC), (TCI: S1) (BIDR: Paulhus, 1991), (TCI: S4), (HPI: No Guilt HIC)
Teamwork	Citizenship, Teamwork, Cooperation	IPIP Scales: 4 IPIP Items: 45 IPIP Alpha: 0.73–0.78 EmoSocio Items: 9	(VIA: Cit), (AB5C: II+/I-), (NEO: A4), (HPI: REL)

social context. SNA can also help to model changes in behavior and relationships that occur in between observation moments (Veenstra et al., 2013). Understanding the broader properties of group dynamics (structural network characteristics, selection processes, behavioral tendencies, and influence processes) is essential for understanding how networks and behaviors develop (Veenstra et al., 2013).

Including indexes derived from the fields of sociometry and SNA to the EmoSocio Model can better explain the development and expression of individuals' emotional intelligence at specific social environments. This may lead to the development of targeted social and emotional training activities as well as contribute to the evaluation of the impact of these activities. In more detail, having access to sociometric and SNA metrics along with the emotional competences of a group can lead to decision such as: (i) how to encourage the social cohesion of a social group

while at the same time discourage the creation or density of antagonistic relations; (ii) explore social choice patterns and correlate them with specific emotional competences; (iii) wisely split the social group in smaller working groups in order to facilitate specific outcomes (e.g., increase in cohesion, productivity, behavioral change); (iv) monitor and predict the temporal evolution of emotional competences depending on the group dynamics and stochasticity of the social environment; (v) evaluate the impact of targeted interventions to emotional competences of individuals and group dynamics towards their behavioral change; (vi) increase group productivity especially if the application domain regards working environments.

To achieve so, upon the systematic literature review of well-established and theoretically sound sociometry and SNA approaches, and by considering our previous work on this domain (Fotopoulou et al.,

Table 4
Direct Sociometric Indexes per group member (Fotopoulou et al., 2021; Bezanilla, 2011).

Symbol	Concept	Description
Sp	Elections status	The number of elections received by each member of the group.
Pp	Perception of election status	The number of elections a member perceives that has been received by the rest of the group members.
Sn	Rejection Status	The number of rejections received by each member of the group.
Pn	Perception of rejection status	The number of rejections a member perceives that has received by the rest of the group members
Rp	Reciprocal elections	The number of elections that are directed to each other.
Rn	Reciprocal rejections	The number of rejections that are directed to each other.
OS	Feeling Opposition	The number of cases where a first group member has chosen a second member negatively and the second group member has chosen the first member positively.
Ep	Positive Expansion	The number of elections a member does towards the rest of the group. This index is meaningful if the number of elections is not a fixed number.
En	Negative Expansion	The number of rejections a member does towards the rest of the group. This index is meaningful if the number of rejections is not a fixed number.
Pap	Guessed right elections' perception	The number of peers a member identified as selectors that, in fact, show preference on him/her.
PAn	Guessed right rejections' perception	The number of peers a member identified as rejecters that, in fact, did reject him/her.

2019; Fotopoulou et al., 2021), we came up with a set of selected sociometric and SNA metrics. These metrics are clustered and form the social constructs of the EmoSocio model.

3.4. Social part of the EmoSocio model

3.4.1. Sociometric indexes and constructs

Sociometry is a quantitative method for measuring social relationships. Sociometric indexes are extracted based on the sociometric matrix produced upon the information collected through a sociometric test. The sociometric test is an instrument that examines social structures through the measurement of the attractions and repulsions (and the perception of them) that take place between the individuals within a group (Fox and Whitaker, 1987). The sociometric test normally consists of 2 or 4 items. Individuals are asked for their social preferences (item 1), their social rejections (item 2), their perception about which individuals think they prefer them (item 3) and their perception about which individuals think they reject them (item 4). The relevant items in the EmoSocio Inventory are made available at the Appendix.

The outcome of a sociometric assessment process is a sociometric matrix that can be represented through a sociogram. Given that information, a set of direct and compound sociometric indexes are extracted per individual and per group. These indexes determine the position of each individual within the group as well as the overall group sociometric status. Table 4 details the indexes that are frequently used in typical sociometric data analysis.

Based on the aforementioned direct sociometric indexes, compound sociometric indexes are also produced, applied at an individual or group level. The former refer to a specific individual within a social group, while the latter to the structure of the group. These indexes are presented in Table 5, along with the formulas used for their calculation. As detailed later in this manuscript, further formulas can be defined -for part of the indexes- based on the type of the interaction examined within a social network (e.g., popularity can be associated with different types of centrality measures).

Based on the indexes detailed in Tables 4 and 5, we have created the main constructs that compose the social part of the Emosocio model. These constructs are classified as individual or group level constructs (see Fig. 7).

3.4.2. Social constructs' scales and items

Given the definition of the social constructs of the EmoSocio model, we have moved on with the specification of the scales for measuring these constructs, as well as the items to be used for data collection. The formulas provided in Table 5 are considered as the main ones used for measurement of the defined scales. However, some of the scales are associated with multiple formulas, based on the application of different SNA algorithms.

For instance, popularity and antipathy (the relevant constructs are defined in Section 3.4.1) can be measured based on different centrality measures. Applying different graph centrality measures makes it possible to identify the most popular or antipathetic nodes in a social network (e.g., based on degree/in-degree/out-degree centrality) in terms of total number of selections or rejections, the nodes that are very good at disseminating information to other nodes (e.g., based on closeness centrality), as well as the nodes that can act as bridges for inter-linking different communities or sub-groups (e.g., based on betweenness centrality). The local clustering coefficient indicates also the degree that a node tends to create clusters and is calculated based on the fraction of pairs of the node's friends that are friends with each other.

Another set of measures can be applied for identifying social structures within a group and evaluating the overall social cohesion (the relevant construct is defined in Section 3.4.1). The global clustering coefficient provides an overall indication of the cohesion in the network. In addition, the average distance measures the average length of the shortest paths between all the nodes, while the diameter measures the maximum distance between any pair of nodes. Low average distance and diameter values characterize groups with high social cohesion. The eccentricity measures the largest distance between a node and all other nodes, while the periphery of a graph refers to the set of nodes that have eccentricity equal to diameter. These nodes can be seen as the less integrated at the social group and may be the focus of emotional training activities. The transitivity measure refers to the extent to which the relation that relates two nodes in a network that are connected by an edge is transitive, revealing the existence of tightly connected communities (or clusters, subgroups, cliques). Similarly, the presence of strongly connected sub-groups can be also identified, leading to insights regarding the formulation of isolated clusters.

Link prediction mechanisms can also provide information related to social expansion indexes (the relevant construct is defined in Section 3.4.1), considering links that are highly probable to be established in the future. Members that are more probable to get connected in the future, will possibly collaborate better between them, accelerating their integration at the social group. Several mechanisms and indexes have been defined for supporting link prediction, such as the common neighbors index (two members who have a friend in common are more likely to be linked), the Jaccard Coefficient (the number of common neighbors normalized by the total number of neighbors), the Resource Allocation index (considers a fraction of a resource that a node can send to another node through their common neighbors), the Adamic/Adar index (predict links according to the amount of shared links between two nodes), and the Preferential attachment score (compute the closeness of nodes, based on their shared neighbors).

Table 5
Compound -individual and group- sociometric indexes (Fotopoulou et al., 2021; Bezanilla, 2011).

Symbol	Construct	Description	Formula
Compound Group Sociometric Indexes			
AI	Association	The number of reciprocal elections considering the group size.	$AI = \sum Rp / (N(N-1))$
DI	Dissociation	The number of reciprocal rejections considering the group size.	$DI = \sum Rn / (N(N-1))$
CI	Cohesion	The relationship between the reciprocal elections in the group and the elections made.	$CI = \sum Rp / \sum Sp$
SI	Social Intensity	Productivity or total group expansiveness.	$SI = (\sum Sp + \sum Sn) / (N-1)$
Compound Individual Sociometric Indexes			
Pop	Popularity	Popularity of a member within the group.	$Pop = Sp / (N-1)$
Ant	Antipathy	How rejected is a member within the group.	$Ant = Sn / (N-1)$
CA	Affective connection	The proportion of congruence between reciprocity and a member's elections	$CA = Rp / Sp$
SS	Sociometric Status	The degree to which someone is liked or disliked by their peers as a group.	$SS = (Sp + Pp - Sn - Pn) / (N-1)$
Expp	Positive Expansion	The tendency of a member to select positively many peers of the group. This index is meaningful only if the number of elections is not a fixed number.	$Expp = Ep / (N-1)$
Expn	Negative Expansion	The tendency of a member to reject many peers of the group. This index is meaningful only if the number of elections is not a fixed number.	$Expn = En / (N-1)$
RPER	Realistic Perception	The degree to which someone correctly identifies the way his/her peers feel about him.	$PA = (PAp + Pan) / (Sp + Sn)$

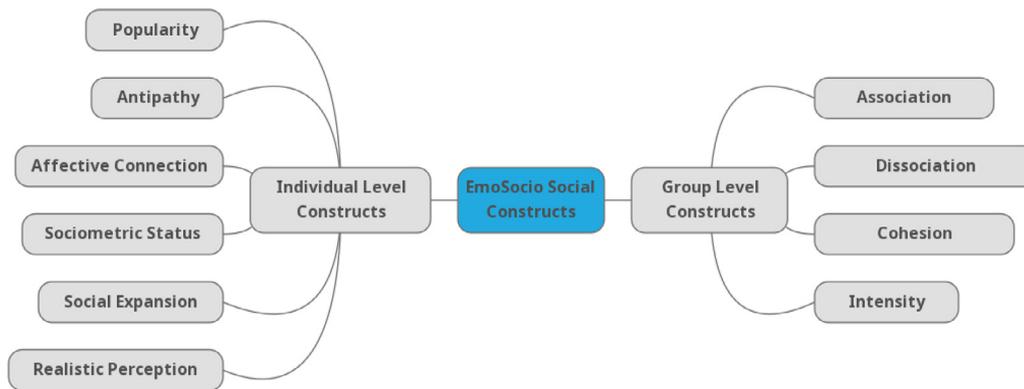


Fig. 7. The EmoSocio Social Constructs.

Table 6
Indicative SNA techniques for measurement of social constructs.

Constructs	Level	Indicative SNA techniques
Popularity, Antipathy	Individual	Degree/in-degree/out-degree centrality, Closeness centrality, Betweenness centrality, Local clustering coefficient
Social Cohesion	Group	Global clustering coefficient, Distance, Diameter, Eccentricity, Periphery, Transitivity
Social Expansion	Group	Common neighbors index, Jaccard Coefficient, Resource Allocation index, Adamic/Adar index, Preferential attachment score

A consolidated non-restrictive view of a set of SNA techniques that can be applied for the measurement of specific EmoSocio social constructs is provided at Table 6.

3.5. The EmoSocio model ontology

Upon the conceptualization of the EmoSocio model, we moved on with the development of the EmoSocio ontology. An ontology, a term borrowed from philosophy, is an explicit specification of a conceptualization. Formally, an ontology is the statement of a logical theory (Gruber, 2009). Within an ontology, the knowledge of a domain is represented in a declarative formalism based on a set of representational terms (e.g., classes, relations, functions, or other objects) with human-

readable text that describe what the names mean and formal axioms that constrain the interpretation and well-formed use of these terms.

The main objective of the EmoSocio Ontology is to formally and unambiguously represent the defined constructs along with their scales and inter-relationships. In this way, the transparency and explainability of the denoted concepts will be increased, facilitating the adoption, re-use and extension of the EmoSocio model by the scientific community. Furthermore, the provision of a clear, consistent and computable representation of the EmoSocio model will enable its comparison, testing and integration with other emerging models or theories, as well as its inclusion by software tools that can support psychological assessment processes. Similar approaches have been already applied for modeling behavioral change theories (West et al., 2019; Hale et al., 2020). In addition to the formal representation of knowledge, usage of an ontology leads to the collection of structured data based on the specified schema in the ontology and, thus, their ease usage by scientists for validation and theories' extension. It should be noted that relevant ontologies are developed for describing emotions and their relative affective phenomena (e.g., EmotionsOnto (Gil et al., 2015), Emotion Ontology (EM) (Hastings et al., 2014), Visualised Emotion Ontology (Lin et al., 2018)) and for representing aspects of affective phenomena in specific domains (e.g., in e-learning (Arguedas et al., 2015)). However, up to our knowledge, the EmoSocio ontology is the first approach to semantically describe the constructs that are present in an EI model, while it also incorporates the social constructs at individual and group level.

The Emosocio ontology is developed based on the W3C Web Ontology Language (OWL) that is a Semantic Web language designed to represent rich and complex knowledge about things, groups of things,

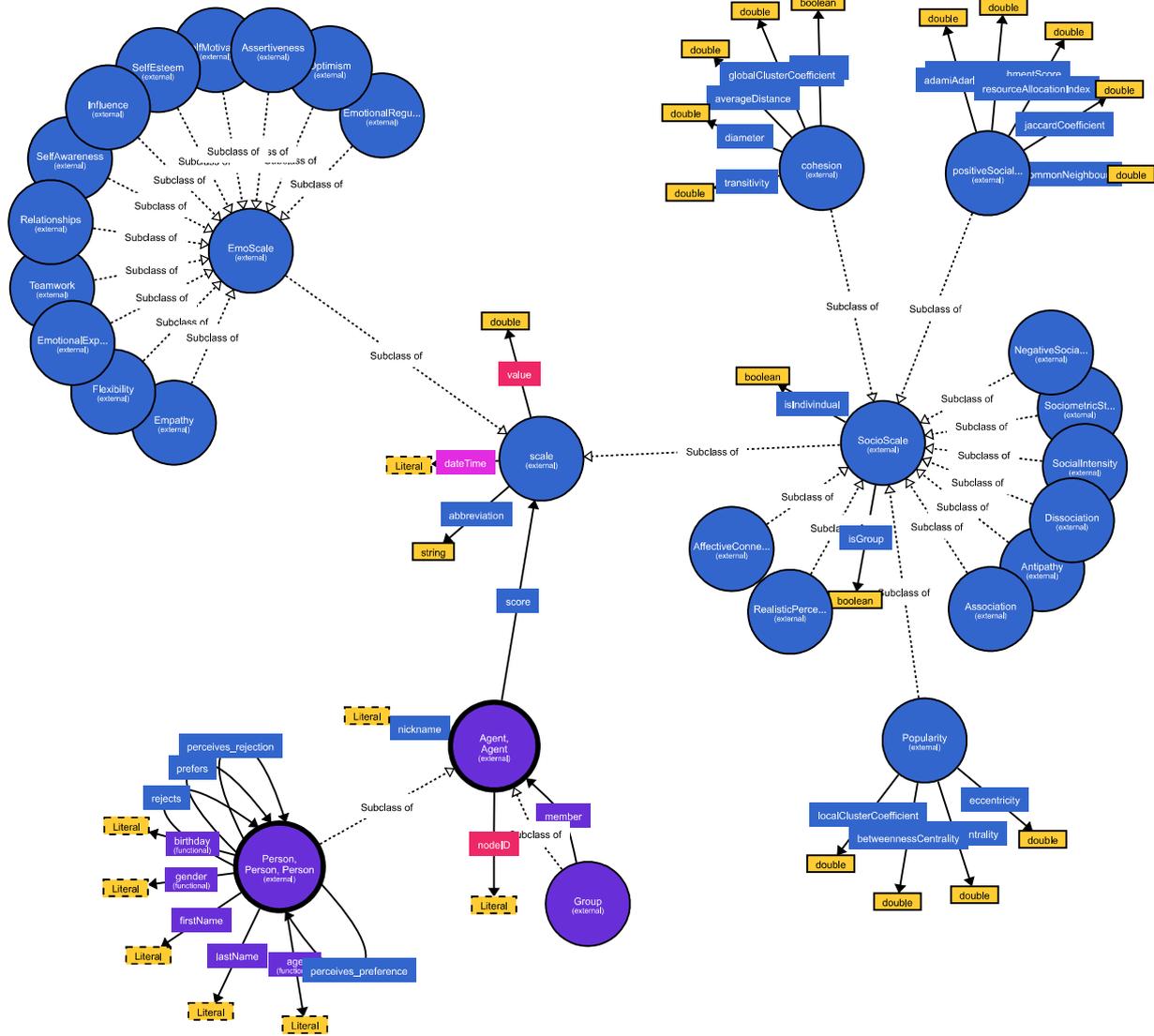


Fig. 8. The EmoSocio Ontology (The EmoSocio Ontology Specification 2020).

and relations between things. The development is based on the adoption of concepts denoted in existing upper ontologies, such as the Friend of a Friend (FOAF) ontology (FOAF Vocabulary Specification 0.99 2020). Other baseline schemas such as the Resource Description Framework (RDF) schema and the (RDF Schema 1.1 2020) XML Schema Definition Language (W3C XML Schema Definition Language (XSD) 1.1 2020) are also used. In this way, we build upon fundamental and widely adopted concepts and semantics and provide the required extensions to introduce the EmoSocio constructs. Following, we shortly describe the main entities included in the EmoSocio ontology (Fig. 8). A detailed specification of the ontology is made available at (The EmoSocio Ontology Specification 2020).

A main entity regards the *Agent* that may represent a *Person* or a *Group*. Each *Person* refers to an individual that may belong to a *Group*. Each *Person* may prefer or reject another *Person*, while it also perceives preference or rejection by other *Persons*. Each *Agent* (whether it is a *Person* or a *Group*) receives scores based on a set of *Scales*. A *Scale* may refer to an emotional construct (*EmoScale*) or a social construct (*SocioScale*) of the EmoSocio model. The *EmoScale* includes as subclasses all the emotional constructs, while the *SocioScale* includes as subclasses all the social constructs. Each *Scale* may be applied to *individual* or *group* level. Each *Scale* includes a set of values that are timestamped. Each *Scale* may

have a *positive or negative influence* on another *Scale*, as well as a *positive or negative influence* over a *relationship*. In this way, relationships among constructs can be represented. Some of the *SocioScales* (popularity, antipathy, social expansion, group cohesion) are accompanied by a set of properties that regard *SNA* algorithms that can be applied for the measurement of the *Scale* (e.g., *Popularity* measured based on the *closenessCentrality* index).

The Emosocio Ontology has been designed using a web application named WebVOWL, that permits the design and interactive visualization of ontologies. It implements the Visual Notation for OWL Ontologies (VOWL) by providing graphical depictions for elements of OWL that are combined to a force-directed graph layout representing the ontology (WebVOWL: Web-based Visualization of Ontologies 2020). A graphical representation of the EmoSocio Ontology is depicted at Fig. 8.

In Table 7 we provide a simplistic example of how the EmoSocio Ontology represents semantically a group, its members and the emotional and social dynamics between them. A *Group* entitled as “research-team-A” is composed by two *Persons*: Bob and Alice. They have a mutual relationship since Bob *prefers* Alice and vice versa. At the same time, Alis has a medium empathy score (45%) while Bob’s empathy is higher (95%). As a *Group*, they have a very high *cohesion* (100%) because they mutually prefer each other. Their *cohesion* is also described by the

Table 7
EmoSocio Ontology Indicative Usage.

```

@base <http://example.org/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix emosocio: <https://pages.gitlab.io/emosocio/> .

<#research-teamA>
  a foaf:Group ;
  foaf:name "research-team-A" ;
  foaf:member <#Bob>;
  foaf:member <#Alice>;
  emosocio:score [
    a emosocio:cohesion;
    rdf:value "100"^^xsd:integer ;
    emosocio:diameter 1 ;
    emosocio:transitivity 0 ;
    xsd:dateTime "2020-10-26T21:32:52";
    emosocio:isGroup true;] .

<#Bob>
  a foaf:Person ;
  foaf:name "Bob Johnson" ;
  emosocio:prefers <#Alice> ;
  emosocio:score [ rdf:value "95"^^xsd:integer ;
    xsd:dateTime "2001-10-26T21:32:52";
    a emosocio:empathy] .

<#Alice>
  a foaf:Person ;
  foaf:name "Alis Papas" ;
  emosocio:prefers <#Bob> ;
  emosocio:score [ rdf:value "45"^^xsd:integer ;
    xsd:dateTime "2001-10-26T21:32:52";
    a emosocio:empathy] .

```

group *diameter* (1) and *transitivity* (0 - since no social triangles exist on it).

4. Results

In this section, we present the results of the assessment of the emotional part of the EmoSocio model. Focus is given of the assessment of the reliability and the validity of the denoted constructs. Reliability refers to the accuracy of the defined scales and, thus, the consistency of the EmoSocio model. It refers to the extent to which it provides the same results if it is used in the same situation on repeated occasions. Validity assesses the accuracy of the model since it is defined as the extent to which its constructs are accurately measured. Regarding reliability, we assessed two types of consistency, namely the over time consistency based on a test-retest approach and the internal (across items) consistency based on the calculation of the Cronbach's α (alpha) and the MacDonald's ω (omega) per construct. Regarding validity, we have examined content and criterion validity. Content validity regards a qualitative assessment along with an assessment based on Confirmatory Factor Analysis (CFA), while criterion validity is examining the inter-relationship of the provided scales (divergent validity), as well as their relevance with associated scales in other measurement tools (convergent validity).

Prior to proceeding to the analysis of the collected self-reported data, we have processed the data to remove outliers related with responses classified as invalid. Outliers may be mainly attributed to careless re-

sponding, misrepresentation due to cheating or faking, linguistic incompetence or misunderstanding (Curran, 2016). To do so, we have applied two techniques for outliers' detection, namely the Mahalanobis distance and the examination of responses in items that are semantic synonyms or antonyms. In the first case we examine, per construct, the distance of the response pattern from the multidimensional center of all responses, while in the second case we examine the absolute average difference in the responses in a set of semantically matched pairs of items with opposite or similar meaning. The aforementioned process has resulted in the identification of 18 outliers out of the 153 participants in the survey, leading to the examination of 135 responses.

4.1. Descriptive statistics

The distribution of the scores of the EI constructs of the EmoSocio model is depicted in Fig. 9, along with mean values and the standard deviation per construct. For the overall EI indicator, the mean value is 68.83 with standard deviation of 7.76.

4.2. Reliability analysis

4.2.1. Test-Retest reliability

Test-retest reliability is used to determine the consistency of a test across time. It is mainly used for concepts that are not very dynamic across time. Emotional intelligence belongs to this category. To measure the test-retest reliability, we have repeated the process for filling in

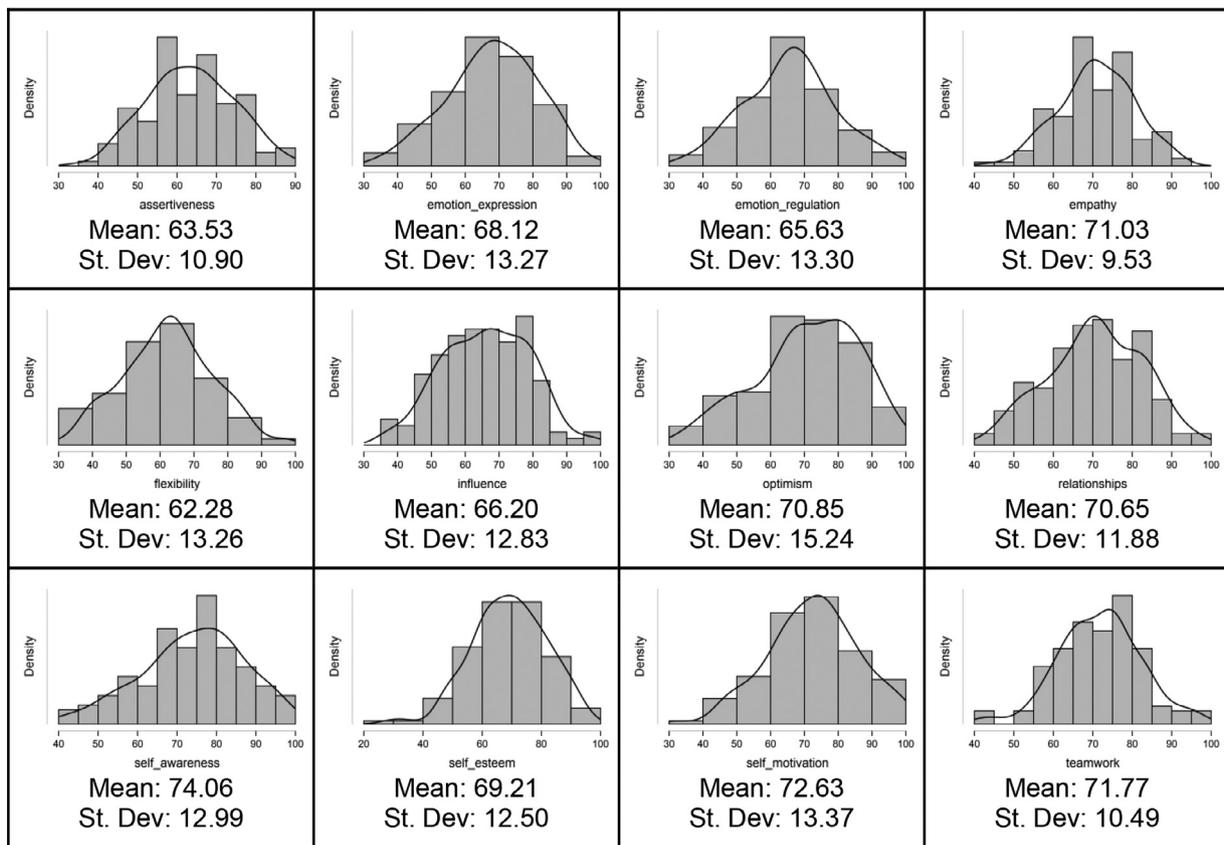


Fig. 9. Distribution of scores per EI construct.

Table 8
Test-Retest Pearson’s r correlations.

EmoSocio Total: Pearson’s r: 0.92, p-value < 0.001			
<u>Assertiveness</u> Pearson’s r: 0.89 p-value < 0.001	<u>Emotion Expression</u> Pearson’s r: 0.93 p-value < 0.001	<u>Emotional Regulation</u> Pearson’s r: 0.86 p-value < 0.001	<u>Empathy</u> Pearson’s r: 0.80 p-value < 0.001
<u>Flexibility</u> Pearson’s r: 0.75 p-value < 0.001	<u>Influence</u> Pearson’s r: 0.81 p-value < 0.001	<u>Optimism</u> Pearson’s r: 0.86 p-value < 0.001	<u>Relationships</u> Pearson’s r: 0.83 p-value < 0.001
<u>Self-Awareness</u> Pearson’s r: 0.86 p-value < 0.001	<u>Self-Esteem</u> Pearson’s r: 0.92 p-value < 0.001	<u>Self-Motivation</u> Pearson’s r: 0.75 p-value < 0.001	<u>Teamwork</u> Pearson’s r: 0.67 p-value < 0.001

the EmoSocio instrument by 20 of the 153 participants in three-weeks’ time. A statistical comparison is made between participant’s test scores for each of the times they have completed it. We calculated the correlation coefficient to examine the strength of the relationship between the data collected in the different time points. The overall EI Pearson’s r correlation index is 0.92 that is considered an indicator of very good stability and, thus, consistency of the test. High Pearson’s r correlation index values are also noted for each of the emotional EmoSocio constructs, as they are presented at Table 8. A scatterplot between the calculated values per construct in the initial test (x axis) and the re-test (y axis) is depicted at Fig. 10.

4.2.2. Internal consistency reliability

Internal consistency is a measure of reliability used to check consistency on the responses of the participants across the items of the questionnaire. It is applied per construct as well as for the overall EI indicator. Given that per construct there are a set of associated items, responses in these items have to be correlated with each other. The most common

measure of internal consistency used by researchers in psychology is Cronbach’s α (the Greek letter alpha) statistic, however the McDonald’s ω (the Greek letter omega) statistic is considered as a related but better alternative (Hayes and Coutts, 2020; Zhang and Yuan, 2016). We have calculated both indicators for all the scales of the EmoSocio Inventory, as well as their global values for the EI construct as a whole. The results are made available at Table 9.

The values of the Cronbach’s Alpha coefficient vary in the range of 0.64 to 0.87, where 5 constructs have values greater than 0.8, 4 constructs have values in the range of 0.7 to 0.8 and 3 constructs have values in the range of 0.6 to 0.7. The overall value for the Cronbach’s Alpha coefficient is 0.94. The values of the McDonald’s Omega coefficient are slightly better and vary accordingly in the range of 0.66 to 0.88, where 6 constructs have values greater than 0.8, 4 constructs have values in the range of 0.7 to 0.8 and 2 constructs have values in the range of 0.6 to 0.7. In both cases, a value of around 0.70 or greater is widely considered desirable, while a very high value of alpha or omega (e.g., greater than 0.95) is not necessarily good, since it might be an

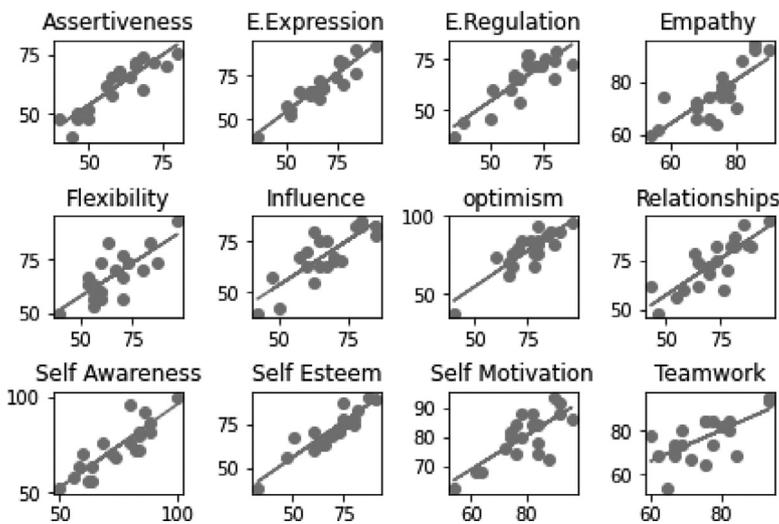


Fig. 10. Scatterplot for relationship of EI construct in different time points.

Table 9
Cronbach's Alpha and MacDonal's Omega Coefficient per Construct.

Scale	Cronbach's α	McDonald's ω	Average inter-item correlation
Optimism	0.87	0.88	0.41
Self-awareness	0.84	0.85	0.34
Self-motivation	0.84	0.84	0.34
Self-esteem	0.80	0.82	0.25
Emotional regulation	0.85	0.87	0.29
Relationships	0.79	0.82	0.24
Emotion expression	0.78	0.78	0.27
Influence	0.74	0.76	0.26
Assertiveness	0.71	0.73	0.20
Empathy	0.66	0.68	0.16
Flexibility	0.67	0.71	0.23
Teamwork	0.64	0.66	0.17

indication of redundancy (Ursachi et al., 2015). Furthermore, the average inter-item correlation varies from 0.16 to 0.41 (ideally, the average inter-item correlation for a set of items should be between 0.20 and 0.40 (Piedmont, 2014)), showing that there is homogeneity across the items, while a sufficiently unique variance between them is maintained so as to not be isomorphic with each other. Overall, it can be claimed that the EmoSocio constructs present good to high internal consistency scores. Such an outcome is considered satisfactory for the theoretical foundation of the model, while adjustments for potential improvements upon further evaluation of the EmoSocio model in the future may take place.

4.3. Validity analysis

4.3.1. Content validity

Content validity examines whether the questionnaire contains questions that cover all aspects of the construct being measured. It is usually evaluated based on the opinion of experts. In our case, content validity is guaranteed, considering the applied methodology for the selection of constructs and scales that is based on the semantic alignment of concepts that are presented in six dominant EI models. Furthermore, the selection of items has been done based on the available pool of items in the IPIP repository, where the validity of each item and the relevant scale is ensured.

To further verify the proper breakdown of the EI construct to intrapersonal and interpersonal sub-constructs, we have realized a Confirmatory factor analysis (CFA) to confirm the existence of a relationship between the observed variables (items) and their underlying latent constructs. We opted to do a CFA instead of an Exploratory Factor Analysis

(EFA) since at this point of time we wanted to verify the appropriate grouping of items to constructs -taking advantage of existing knowledge and verified repositories- and not to get suggestions for their potential grouping. The results of the CFA analysis are made available at Table 10. We notice that the EmoSocio model has a very good fit with regards to the intrapersonal constructs, as well as a good fit as for all the EmoSocio constructs based on the Chi-square goodness of fit statistic, while small adjustments may be required in the case of the interpersonal constructs where the indicators are close to the thresholds between a good fit and a fit that needs improvement. Such adjustments have to take place upon extensive assessment of the EmoSocio model and may regard re-structuring of part of the selected items per construct or even merging of a small part of the interpersonal constructs (e.g., the teamwork and relationship constructs).

4.3.2. Criterion validity

Criterion validity examines the extent to which people's scores on a measure are correlated with other variables (known as criteria). As already noted, we examine convergent validity and divergent validity.

In the case of convergent validity, we examine the correlation of EmoSocio constructs with relevant constructs measured by existing and well-known measurement tools. High correlation among the similar constructs is envisaged to validate the accurate assessment of the construct. To measure the convergent validity, we have asked from 20 of the 153 participants to fill in the questionnaires provided by Petrides (short version of the TEIQue-SF (Obtaining the TEIQue 2020) based on the Trait EI model by Petrides), the Schutte Self-Report Emotional Intelligence Test (SSEIT) (Schutte Self-Report Emotional Intelligence Test (SSEIT) 2020) (based on the Ability EI model by Salovey and Mayer) and the short form for the IPIP-NEO questionnaire (The IPIP-NEO 2020) (based on the Five-factor model). Following, we calculated the Pearson's r correlation index among constructs that have close semantic matching. In case of semantic alignment with multiple constructs, average values were calculated. The produced results are made available in Table 11. For the overall EI indicator, high correlation exists between the EmoSocio model and each of the Five Factor ($r = 0.83$), Petrides' Trait EI ($r = 0.77$) and Schutte's Ability EI ($r = 0.76$) models. Average to high correlation values are also calculated considering the relationship of EmoSocio constructs with existing constructs in the aforementioned three models. Such results are considered encouraging in terms of validity of the EmoSocio constructs and the semantic alignment process that has been followed.

In the case of divergent (or discriminant) validity, we check whether concepts or measurements that are not supposed to be related are poorly correlated. A low to moderate correlation is considered as a proof of discriminant validity (Ursachi et al., 2015). Within EmoSocio, we check

Table 10
Confirmatory Factor Analysis' Results.

Goodness of fit indicator	Intrapersonal Constructs	Interpersonal Constructs	All EmoSocio Constructs
Chi-square goodness of fit statistic (X^2/df) [*]	1.24	2.25	1.99
RMSEA (Root Mean Square of Error Approximation)**	0.05	0.08	0.08
CFI (Comparative Fit Index)***	0.96	0.87	0.85
NNFI (Non-Normed Fit Index)***	0.97	0.87	0.86

* [close to 1: very good fit, 1-2: good fit, 2-5: needs improvement, > 5: bad fit].

** [≤ 0.05 : very good fit, 0.05-0.08: good fit, 0.08-0.1: needs improvement, > 0.1: bad fit].

*** [≥ 0.95 : very good fit, 0.9-0.95: good fit, 0.8-0.9: needs improvement, < 0.8 bad fit].

Table 11
Correlation between similar constructs.

Third party Instrument / EmoSocio Construct	Five Factor	Petrides (Trait EI)	Schutte (Ability EI)
Emotional Intelligence	Related Constructs: Extraversion, Agreeableness, Conscientiousness, Neuroticism (-), Openness Pearson's r: 0.83, p-value: < 0.001	Related Constructs: Emotional Intelligence Pearson's r: 0.77, p-value: < 0.001	Related Constructs: Emotional Intelligence Pearson's r: 0.76, p-value: < 0.005
Emotional regulation	Related Constructs: Cautiousness, Self-Discipline, Anxiety (-), Anger (-), Depression (-), Immoderation (-) Pearson's r: 0.78, p-value: < 0.001	Related Constructs: Self-control Pearson's r: 0.75, p-value: < 0.001	Non applicable
Optimism	Related Constructs: Cheerfulness, Depression (-) Pearson's r: 0.81, p-value: < 0.001	Non applicable	Non applicable
Relationships	Related Constructs: Friendliness Pearson's r: 0.58, p-value: < 0.008	Non applicable	Non applicable
Empathy	Related Constructs: Altruism, Sympathy Pearson's r: 0.70, p-value: < 0.001	Non applicable	Non applicable

the divergent validity based on the correlation coefficients between different EmoSocio constructs to ensure that theoretically-based non-overlapping constructs do not significantly overlap. To do so, a correlogram is produced for the statistically significant correlations (p -value < 0.01), as depicted at Fig. 11. Given that the measured correlation indexes are in most of the cases lower than 0.6 (low to moderate correlation values), no major overlapping is identified among the EmoSocio constructs.

5. Discussion

5.1. Discussion and concluding remarks

In the current manuscript we have introduced and devised the EmoSocio model, starting from its conceptualization and proceeding with a primary assessment of the validity and reliability of the defined emotional scales. EmoSocio regards a reframing of existing knowledge around EI and is composed based on the semantic alignment of constructs in existing EI models. It regards the first approach –to the best of our knowledge- that represents jointly emotional and social constructs, aiming to facilitate participatory modeling and psychological assessment studies by multidisciplinary scientists (e.g., psychologists, sociologists). Upon a thorough review of existing work in both the emotional and social part of the model, we have come up with the conceptualization of the EmoSocio model, consisting of 12 emotional constructs and 10 social constructs. Per construct, a set of items are selected for assessment purposes based on existing widely used and validated inventories. The full set of items compose the EmoSocio Inventory.

Subsequently, a reliability and validity assessment has taken place for the emotional part of the EmoSocio model. This assessment is considered as a primary evaluation of the EmoSocio model to provide initial feedback regarding its validity and reliability. The social part of the model is not included in the assessment, since it regards well-

formulated constructs based on theoretically sound works in sociometry and SNA. Based on the analysis results, it is shown that the proposed model achieves high scores in terms of reliability and validity indicators. Consistency of the model is present, considering both internal consistency across items as well as consistency across time. High values are calculated for the McDonald's omega and the Cronbach's alpha coefficients, where the majority of the constructs are associated with values higher than 0.7, while the overall Cronbach's alpha value for the EmoSocio model is 0.94. For the constructs that present internal consistency values lower than 0.7 (0.66 for teamwork and 0.68 for empathy for the McDonald's omega coefficient), further evaluation and fine-tuning of part of the selected items of the model is required. High consistency of the test across time is also shown.

The model is also valid since both content and criterion validity has been successfully applied. A CFA analysis has taken place showing a good fit of the defined constructs with the collected data in the study, while insights for potential adjustments in the future to further improve the overall fit are extracted. Convergent and divergent validity is examined, showing small correlation among the defined constructs in the EmoSocio model and high correlation with part of existing constructs in other EI models. Once again, these results are satisfactory and promising for the current version of the model, while extended evaluation studies are required to come up with further results related to the relationship among constructs.

The developed EmoSocio EI model is an open-access model. Openness was one of the major motivation factors for the conceptualization of the EmoSocio model. Transparency in terms of the constructs' definition, the associated scales and items is provided, aiming to make it self-explainable and easily adoptable by a wide research community. Based on the provision of an open-access model, we envision to provide to the scientific community a valuable toolset for developing social and emotional training activities and being able to assess their impact. Openness regards also the release of the col-

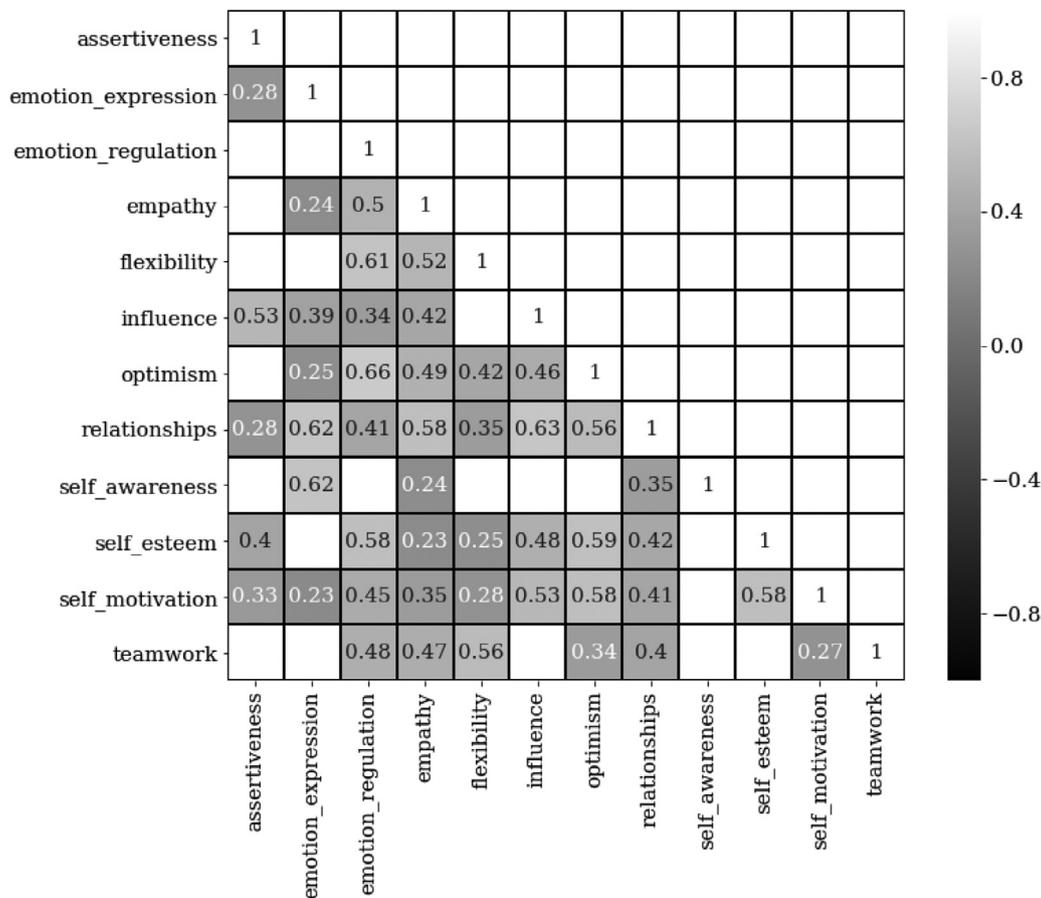


Fig. 11. Divergent validity scores between EI EmoSocio Scales.

lected data to support reproduction and extension of the realized research.

The EmoSocio Ontology ([The EmoSocio Ontology Specification 2020](#)) has been also publicly released to formally and unambiguously represent the defined constructs along with their scales and interrelationships. Existence of an ontology is important for the interlinking of the EmoSocio model with other models and for enabling its integration and comparison with other emerging models or theories. Given that it is the first EI model that is conceptually represented in the form of an ontology, it may also act as a navigator for similar modeling approaches for other EI models. Openness regards also the release of the collected data to support reproduction and extension of the realised research ([Fotopoulou et al., 2020](#)).

The assessment of the EmoSocio model has been realized based on an initial evaluation campaign with the participation of 153 individuals. Such a participation was helpful for assessing the reliability and validity of the EI constructs of the model, including the examination of the relevance of the denoted constructs with similar constructs in existing EI models. However, the comparison among similar constructs was feasible only in cases where the assessment formulas were made openly available by the associated measurement instruments (e.g., in the case of the short version of the TEIQue-SF ([Obtaining the TEIQue 2020](#)) and the Schutte Self-Report Emotional Intelligence Test (SSEIT) ([Schutte Self-Report Emotional Intelligence Test \(SSEIT\) 2020](#))) or in cases where free access to the assessment results was available online (e.g., in the case of the short form for the IPIP-NEO questionnaire ([The IPIP-NEO 2020](#))). We consider that the existing assessment has to be accompanied with extensive assessment studies in the future, potentially leading to slightly revised versions of the model. Another limitation of the current study regards the absence of a joint assessment of the emotional intelligence

and social constructs of the model. To achieve so, there is a need for implementation of social and emotional interventions in targeted groups of people, followed by an assessment of the achieved outcomes in terms of evolution of all the EmoSocio constructs and the identification of interrelationships among them.

5.2. Open research areas and future work

The release of the EmoSocio model paves the way for the support of interdisciplinary research, combining efforts by psychologists, sociologists and computer science researchers. The blending of sociometric indexes with emotional intelligence concepts opens new horizons towards the development and evaluation of social and emotional training activities. Collection of both sociometric and emotional intelligence data can take place under the same model. Processing of such data can lead to better understanding of the interplay among emotional intelligence and social interaction indicators and reveal hidden relationships between constructs. In parallel, the development of software tools able to support the data collection, processing and automated analysis process is supported, taking advantage of the formal representation and structuring of the data under the specification of the EmoSocio Ontology. Reusability, interoperability and extensibility of the applied studies can be guaranteed.

Another interesting concept that is emerging regards the concept of collective emotional intelligence (CEI). Most of the emotional intelligence research up to now has focused on individuals, however, emotional intelligence can also be conceptualized as a collective or group characteristic. Actually, CEI is defined as the ability of a group to develop a set of norms that encourage expression, awareness, and regulation of the affective dynamics within the group, improving the ability of

group members to work together effectively (Druskat and Wolff, 2001). CEI can be seen as the sum of the individual emotional intelligence of the group members or as the degree of emotional intelligence that the group members appear to use when they interact with each other (Curşeu et al., 2015). In the latter case, focus is given on the way that emotional intelligence is used in interaction among group members. CEI can have direct effects on the performance and the cohesion of a group, as well as the better support of conflict resolution mechanisms. A positive association is also noticed between the number of friendship ties with the emergence of CEI (Curşeu et al., 2015). The EmoSocio model can be easily adopted and extended to support conceptualization and evaluation of studies related to CEI, given that we consider both individual and group characteristics in the denoted social constructs and we can easily extend this classification to the emotional constructs.

Data and Code Availability Statement

The research data and the specification of the EmoSocio Ontology are made openly available, as detailed in section 2.3 of the manuscript.

Table A.1
EmoSocio Inventory Items.

EmoSocio Scale	Items (+)	Items (-)	# of Items
Self - Awareness	<ul style="list-style-type: none"> - Think about the causes of my emotions. - Pay a lot of attention to my feelings. - Am usually aware of the way that I'm feeling. - Notice my emotions. - Often stop to analyze how I'm feeling. 	<ul style="list-style-type: none"> - Rarely think about how I feel. - Rarely analyze my emotions. - Am not in touch with my feelings. - Often ignore my feelings. - Rarely notice my emotional reactions. 	10
Empathy	<ul style="list-style-type: none"> - Am good at sensing what others are feeling. - Understand people who think differently. - Anticipate the needs of others. - Know what to say to make people feel good. - Take time out for others. 	<ul style="list-style-type: none"> - Don't like to get involved in other people's problems. - Get annoyed with others' behaviors. - Don't understand people who get emotional. - Find it hard to forgive others. - Am quick to judge others. 	10
Emotional Regulation	<ul style="list-style-type: none"> - Experience very few emotional highs and lows. - Remain calm under pressure. - Don't let little things anger me. - Let others finish what they are saying. - Am not easily frustrated. - Rarely feel depressed. - Reflect on things before acting. 	<ul style="list-style-type: none"> - Change my mood a lot. - Do things I later regret. - Get upset by unpleasant thoughts that come into my mind. - Often worry about things that turn out to be unimportant. - Am nervous or tense most of the time. - Talk even when I know I shouldn't. - Lose my temper. 	14
Flexibility	<ul style="list-style-type: none"> - Adapt easily to new situations. - Am good at taking advice. 	<ul style="list-style-type: none"> - Am annoyed by others' mistakes. - Want to have the last word. - Get upset if others change the way that I have arranged things. - React strongly to criticism. - Wait for others to lead the way. - Am afraid to draw attention to myself. - Find it difficult to approach others. - Am not good at planning group activities. - Have difficulty expressing my feelings. - Am not good at describing the emotions I feel throughout the day. - Keep my feelings to myself, regardless of how unhappy I am. - Reveal little about myself. - Wish I could more easily show my negative feelings. - See difficulties everywhere. - Am often in a bad mood. - Have a dark outlook on the future. - Feel that my life lacks direction. 	6
Influence	<ul style="list-style-type: none"> - Persuade others to change their views - Know how to captivate people. - Am good at helping people work well together - Try to lead others. 	<ul style="list-style-type: none"> - React strongly to criticism. - Wait for others to lead the way. - Am afraid to draw attention to myself. - Find it difficult to approach others. - Am not good at planning group activities. - Have difficulty expressing my feelings. - Am not good at describing the emotions I feel throughout the day. - Keep my feelings to myself, regardless of how unhappy I am. - Reveal little about myself. - Wish I could more easily show my negative feelings. - See difficulties everywhere. - Am often in a bad mood. - Have a dark outlook on the future. - Feel that my life lacks direction. 	8
Emotion Expression	<ul style="list-style-type: none"> - Am able to describe my feelings easily. - Express my affection physically. - Hug my close friends. - Tell people about it when I'm irritated. - Express my happiness in a childlike manner. 	<ul style="list-style-type: none"> - Am not good at describing the emotions I feel throughout the day. - Keep my feelings to myself, regardless of how unhappy I am. - Reveal little about myself. - Wish I could more easily show my negative feelings. - See difficulties everywhere. - Am often in a bad mood. - Have a dark outlook on the future. - Feel that my life lacks direction. 	10
Optimism	<ul style="list-style-type: none"> - Look at the bright side of life. - Remain hopeful despite challenges. - Can find the positive in what seems negative to others. - Think about what is good in my life when I feel down. - Have a lot of fun. - Feel lucky most of the time. 	<ul style="list-style-type: none"> - See difficulties everywhere. - Am often in a bad mood. - Have a dark outlook on the future. - Feel that my life lacks direction. 	10
Assertiveness	<ul style="list-style-type: none"> - Say what I think. - Demand explanations from others. - Challenge others' points of view. - Stick up for myself. - Am not afraid of providing criticism. 	<ul style="list-style-type: none"> - Can't stand confrontations. - Feel guilty when I say "no." - Let others make the decisions. - Hold back my opinions. - Hate to seem pushy. 	10

(continued on next page)

Table A.1 (continued)

EmoSocio Scale	Items (+)	Items (-)	# of Items
Self-motivation	<ul style="list-style-type: none"> - Never give up. - Turn plans into actions - Plunge into tasks with all my heart. - Go straight for the goal. - Accept challenging tasks. 	<ul style="list-style-type: none"> - Need a push to get started. - Find it difficult to get down to work. - Undertake few things on my own. - Put little time and effort into my work. - Am easily discouraged. 	10
Relationships	<ul style="list-style-type: none"> - Talk to a lot of different people at parties. - Get along well with people I have just met. - Have the ability to make others feel interesting. - Know that there are people in my life who care as much for me as for themselves. - Try to forgive and forget. - Trust others. 	<ul style="list-style-type: none"> - Don't know how to handle myself in a new social situation. - Often feel uncomfortable around others. - Find it difficult to approach others. - Reveal little about myself. - Have difficulty expressing my feelings. - Keep others at a distance. 	12
Self - esteem	<ul style="list-style-type: none"> - Know my strengths. - Am not embarrassed easily. - Think highly of myself. - Feel comfortable with myself. - Know that my decisions are correct. 	<ul style="list-style-type: none"> - Worry about what people think of me. - Have a low opinion of myself. - See other people as my competitors. - Question my ability to do my work properly. - Am less capable than most people. - Am afraid to draw attention to myself. 	11
Teamwork	<ul style="list-style-type: none"> - Enjoy being part of a group. - Don't miss group meetings or team practices. - Support my teammates or fellow group members. - Feel I must respect the decisions made by my group. - Don't talk badly to outsiders about my own group. 	<ul style="list-style-type: none"> - Work best when I am alone. - Impose my will on others. - Feel that people have a hard time understanding me. - Suspect hidden motives in others. 	9
All Social Scales	<ul style="list-style-type: none"> - Name the members of your team you mostly hang out with - Name the members of your team that you think they prefer to hang out with you 	<ul style="list-style-type: none"> - Name the members of your team you less hang out with - Name the members of your team that you think they do not prefer to hang out with you 	4
Total items	115 Emotional Items (excluding duplicates) and 4 sociometric items		119

CRedit authorship contribution statement

Eleni Fotopoulou: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing. **Anastasios Zafeiropoulos:** Conceptualization, Formal analysis, Investigation, Writing - original draft, Writing - review & editing. **Symeon Papavassiliou:** Conceptualization, Validation, Writing - review & editing.

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