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Instituto de Psicologia

Programa de Pós-Graduação em Psicologia Social, do Trabalho e das Organizações

The proposal and initial exploration of the connectedness and loneliness model (CLM)

Doutorado

André Luiz Alves Rabelo

Brasília, DF

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Orientador: Prof. Dr. Ronaldo Pilati

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Resumo

A presente tese teve os objetivos de revisar criticamente a literatura que investiga a conectividade social e a solidão, especialmente no quanto às conceituações e procedimentos de mensuração que têm sido mais usados. Este trabalho também pretende propor um modelo que sintetize o conhecimento atual, sugira novas direções para conceituar a conectividade social e a solidão - o modelo de conectividade e solidão (CLM) - e explorar empiricamente alguns dos seus principais pressupostos e implicações. Foram realizados seis estudos utilizando diferentes métodos para atingir esses objetivos. Os estudos forneceram evidências que levantam questionamentos sobre muitos aspectos da forma como a conectividade social e a solidão foram conceituadas e medidas na psicologia social nas últimas décadas. Esses estudos ofereceram diferentes contribuições para o campo como evidências em favor da abordagem multidimensional para a conectividade e a solidão, ao mesmo tempo em que indicaram que a validade da escala UCLA de solidão é questionável e que há evidências contra a hipótese de bipolaridade. O modelo de conectividade e solidão (CLM) é a principal contribuição teórica da presente tese, pois é o primeiro modelo formal que descreve explicitamente uma rede nomológica com processos antecedentes e consequentes que visam explicar a diversidade de efeitos de conectividade e solidão na saúde e receptividade/evitação social. Três diferentes procedimentos de mensuração também foram desenvolvidos ou adaptados para o Brasil e agora podem ser usados por outros pesquisadores. Os resultados dos estudos foram coerentes com alguns pressupostos do CLM, o que é uma indicação de sua potencial utilidade.

Palavras-chave: conectividade social, solidão, necessidade de vínculo, isolamento social, modelo de conectividade e solidão

Abstract

The present dissertation had the goals of critically reviewing the literature that investigates social connectedness and loneliness, especially regarding the conceptualizations and measurement procedures that have been mostly used. This work also aims to propose a model that synthesizes current knowledge, suggest new directions for conceptualizing social connectedness and loneliness – the connectedness and loneliness model (CLM) –, and to empirically explore of some of its core assumptions and implications. Six studies using different methods were conducted to reach these goals. The studies provided evidence that raise questions about many aspects of the way social connectedness and loneliness have been conceptualized and measured in social psychology for the last decades. These studies offered different contributions to the field, such as evidence in favor of a multidimensional approach to connectedness and loneliness while indicating that the validity of the UCLA loneliness scale is questionable and that there is evidence against the bipolarity hypothesis. The connectedness and loneliness model (CLM) is the main theoretical contribution of the present dissertation as it is the first formal model that describes explicitly a nomological net with antecedent and consequent processes that aims to explain the diversity of effects of connectedness and loneliness on health and social receptivity/avoidance. Three different measurement procedures were also developed or adapted to Brazil and now can be used by other researchers. The results of the studies were coherent with some assumptions of the CLM, which is an indication of its potential usefulness.

Keywords: Social connectedness, loneliness, need to belong, social isolation, connectedness and loneliness model

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The fact that humans are an ultra-social species as a result of its evolutionary past presents many consequences for their nowadays thought processes and behaviors (Tomasello, 2014). For example, the need to connect with others and form long-term and meaningful social relationships is argued to be amongst the most basic and universal human needs (Baumeister & Leary, 1995). Attending or not to this need might lead to significant consequences (Cacioppo, Hawkley, Norman, & Berntson, 2011; Holt-Lunstad, Smith, & Layton, 2010; House, Landis, Karl, & Umberson, 1988), both positive if it is attended or negative, if it is not attended. Social connectedness and loneliness are commonly considered to be important psychological constructs related to the need to belong: by experiencing social connectedness, the need to belong is momentarily satisfied, and loneliness is experienced when a person perceives the quality of its social relationships as discrepant from its desired social relationships (Cacioppo & Hawkley, 2009a) .

The goals of the present dissertation are to: 1) critically review the theory and measurement of social connectedness and loneliness; 2) propose a model named as the connectedness and loneliness model; 3) explore some of the assumptions and implications of this model. To reach these goals, we make use of: a theoretical exploration of how these constructs have been conceptualized in the literature; a psychometric exploration of how these constructs have been measured; and an empirical exploration to produce systematic evidence about how these constructs are associated with one another and with other relevant criterion variables. These studies offer a series of potential intellectual contributions to the scientific study of these topics. In a broad sense, the proposed investigation can help to clarify our theoretical understanding of these constructs, which is also potentially beneficial to increase the impact of practical applications and interventions that have been developed in the field of social psychology, which do not always have the expected effectiveness (Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015). This investigation also will offer tools to other

researchers interested in studying social connectedness, loneliness, and the need to belong in Brazil, considering the dearth of measures presently available for use and baseline estimates of these parameters in the population. We have developed or adapted three different measures of social connectedness or loneliness along the studies as primary or secondary goals that will be available to researchers all over the country. In that sense, the present work will contribute to increase the understanding of these important phenomena in Brazil and also incentive cross-cultural research (Smith, Fischer, Vignoles, & Bond, 2013) which ultimately can increase our understanding of these universal and basic psychological constructs.

Study 1 is a critical review about the theories and conceptualizations that have been used to define and measure social connectedness and loneliness. Our main conclusions about the literature and the alternative model that has been developed in Study 1 form the basis from which all the other studies described in the present dissertation derive. The specific goals of each study aim to explore some of the most important issues raised as problematic or unexplored in Study 1, although it would not be possible to explore all the issues in the available period for the conduction of the doctorate degree. In Study 2, we translated and adapted to Brazilian Portuguese a measure of social connectedness. The goal in Study 3 was to estimate the relationship between social connectedness, loneliness, and the need to belong using some of the most influential and adopted measures of these constructs in the world. Study 4 had the goals of developing an alternative measurement procedure of social connectedness, comparing the predictive power of social connectedness, loneliness, and social support regarding mental health and satisfaction with life, and estimate the short-term stability of the constructs captured by the measures. In Study 5, we adapted a multidimensional measure of loneliness to Brazilian Portuguese and compared the predictive power of different types of measures of social connectedness and loneliness regarding mental health and satisfaction with life. Finally, in Study 6, we tested the effect of an experimental manipulation

of social connectedness on measures of social connectedness, loneliness, and satisfaction with life and compared the predictive power of social connectedness and loneliness regarding satisfaction with life.

During the last three years, we developed six studies using a variety of scientific methods, such as theoretical, survey, cross-sectional, and experimental methods that have produced different sources of relevant information to initially explore important issues of the field of social psychology in innovative ways. We planned our studies in search for a balance between relevance and viability considering that the process of level exchange from the master's degree to the doctorate's degree decreased the total amount of time to finish the graduation process. Another worry in the present dissertation's planning was to develop studies with high standards regarding its methodological, statistical, and ethical aspects. We also tested repeatedly the replicability of many of our findings to be more confident about our conclusions. We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study (Simmons, Nelson, & Simonsohn, 2012).

Study 1: All the Lonely People, Where Do They All Come From? Where Do They All Belong? A Critical Review of Social Connectedness and Loneliness

The anime character Shinji Ikari is a good example of a lonely person. He must pilot a mysterious and giant being called Evangelion (or just "Eva") in the Japanese anime from 1995 known as Neon Genesis Evangelion. Shinji is only 14 years old when he is suddenly requested by his father that abandoned him as a child to pilot the Eva to save humanity from the so called "angels" that are threatening humanity – which are giant and highly destructive monsters appearing on Earth. Although a great focus is given to the combats between the Evas and the angels, the anime also explores the deep feelings of loneliness, rejection, insecurity, and confusion that torment Shinji's mind. Shinji has always been hurt by his father's abandonment and now he sees himself pressured by his father that shows no positive feelings for him and is asking him to put his life at risk. Shinji's mother died when he was a kid and he also had few friends as an adolescent. Although he is a lonely person in a broad way, one of the main sources of his negative feelings seems to come from the lack of affection exhibited by his father towards him and the past rejection.

Does it matter where all the loneliness that lonely people experience come from? Does it come in many forms or is the experience of loneliness pretty much the same in terms of characteristics, antecedents, and consequences? Is any of these conceptualizations more informative or useful in comparison to one another? For example, is the perception of social isolation from the family different from the perception of social isolation from friends or from a romantic partner? Could it have different impacts on people´s physical and mental health? Is one of them more important? These are all basic questions in the social psychology of loneliness and social connectedness that are far from answered considering the current state of the art.

Psychological science has increasingly made clear that human beings are motivated to develop and maintain meaningful and lasting relationships with at least a certain amount of people across their lives (Baumeister, 2012). This desire for meaningful social relationships is often called in psychology the need to belong, need for social connectedness, or affiliation motive, and as a basic and universal interpersonal need it is believed to drive many aspects of people's lives. Also, according to the literature, satiating (or not) this need across one's lifespan may repeatedly trigger two different feelings – social connectedness or loneliness. Loneliness is experienced when the need to belong is not satisfied and can be considered a major health risk factor according to studies (Cacioppo, Hawkley, Norman, & Berntson, 2011; Cacioppo & Hawkley, 2009a; Hawkley & Cacioppo, 2010). On the other hand, studies about social connectedness indicate that it is experienced when the need to belong is satiated and it may lead to increased happiness, well-being, positive emotions, and many other health, psychological, and behavioral related variables (S. Cohen, 2004; Cruwys, Haslam, Dingle, Haslam, & Jetten, 2014a; House et al., 1988; Kok, Coffey, et al., 2013; Lee, Dean, & Jung, 2008; Lee & Robbins, 1998; Leiberg, Klimecki, & Singer, 2011; Mauss et al., 2011; Seppala, Rossomando, & Doty, 2008).

Although empirical knowledge about these variables has increased in the last years, their nature and relationships between one another are still lacking a precise and unified theoretical account. What exactly are social connectedness and loneliness? How are they related to each other and to other closely related concepts such as social support, attachment style, psychological distance, and social exclusion? Are social connectedness and loneliness inevitable psychological outcomes from satiating the need to belong? Are increased experiences of social connectedness and loneliness similarly impactful in people's health and behavior in terms of magnitude? In other words, what do we really need: to feel connected or to avoid loneliness? Are these the same thing or not necessarily? The goal of the present

thesis is to describe the most influential theoretical understandings of social connectedness and loneliness, to point out their convergences and limitations, to evaluate the way these phenomena have been measured and operationalized in the field of social psychology, and to propose a unified theoretical account named as the connectedness and loneliness model (CLM).

Loneliness

But is loneliness a feeling, a perception, or something else? Is it a cognitive appraisal of one's social circumstances or the cognitive/emotional response to such a cognitive appraisal? Although this might be apparently an armchair philosopher matter, conceptual clarity about phenomena under scientific investigation is crucial because it determines how we decide to measure it, what theories we use to predict hypothesis about the phenomenon, and what predictions we make about its relationship with other psychological variables. Ignoring conceptual issues may lead to less useful understanding of the phenomena of interest and a lack of knowledge accumulation. This could happen because researchers may be studying very similar phenomena using different names with loose definitions or studying different phenomena as if they were interchangeable.

Different terms have been interchangeably used in the literature to refer to this phenomenon, such as loneliness, social isolation, solitude, social exclusion, and social disconnectedness. Research on loneliness often conceptualize it as a perception of social isolation (J. T. Cacioppo, Cacioppo, Capitanio, & Cole, 2015; J. T. Cacioppo & Hawkley, 2009b; Cramer & Barry, 1999; Hughes, Waite, Hawkley, & Cacioppo, 2004; Lisa Jane Wood, 2014) or as a "distressing feeling that accompanies the perception that one's social needs are not being met by the quantity or especially the quality of one's social relationships" (p. 218, Hawkley & Cacioppo, 2010). In the first definition, loneliness is conceptualized as a purely cognitive process of momentarily perceiving the lack of social relationships surrounding a

person. This definition is silent regarding the emotional dimension of the phenomenon and does not account for the stability with which this phenomenon can be experienced (i.e. chronic lonely people) (Vanhalst et al., 2015).

Another common definition of loneliness is that it is an unpleasant experience triggered by the perception of discrepancy between the desired and achieved levels of social bonds (Perlman & Peplau, 1981). There are also other authors such as Weiss that conceptualize loneliness as a feeling that results from perceiving a deficit in one or more relational domains and propose that there are two types of loneliness (DiTommaso & Spinner, 1997; Weiss, 1973): one resulting from social isolation and another resulting from emotional isolation. These two types of loneliness would encompass different experiences that are differently related to other variables, such as social provisions (DiTommaso & Spinner, 1997) and well-being (Jose, Ryan, & Pryor, 2012). Social isolation is related to a lack of integration and relationships with others, while emotional isolation is a result from the absence or loss of an intimate and important relationship.

Another theoretical proposal is the evolutionary model of loneliness (Cacioppo et al., 2006). The model is more focused on explaining the probable evolutionary reasons for the universality of the need to belong in humans. According to this model, loneliness is a feeling that co-opts the social/physical pain system of the brain to work as a social alarm that increases the probability of survival and replication of the "selfish genes". Loneliness would be an alert that motivate the person to re-establish social connectedness but it would also motivate the person to perceive threats in their environment as loneliness would be a sign of current vulnerability. The reasoning underlying this proposal is that ancient hunter gatherers more capable of developing social connectedness toward others, cooperating, and experiencing loneliness as an aversive social alarm would have evolutionary advantage and seek more social integration than hunter gatherers that did not. Those less sensitive to social

connectedness would be more likely to abandon their groups or be socially isolated more often and consequently would be more vulnerable to predators, rivals' attacks, lack of resources, and the death of their abandoned offspring.

The debate about whether loneliness would be better understood as a unidimensional or multidimensional construct is far from a consensus, but this aspect can have many important implications on the research that has been carried out lately (Cramer & Barry, 1999). There is substantial evidence showing that different dimensions of loneliness have different patterns of relationships with other variables and this evidence corroborates the view that loneliness should be understood as a multidimensional construct. According to a review about loneliness measures (Cramer & Barry, 1999), there are many problematic issues in the way scientists have been measuring loneliness.

Firstly, the UCLA Loneliness Scale (UCLA) (Russell, 1996), probably the most used measure in the field of social psychology (Cramer & Barry, 1999), has problematic limitations not yet explored deeply by previous authors (see Study 3 in the present dissertation) (Austin, 1983; Barroso, Andrade, Midgett, & Carvalho, 2016; Hawkley, Browne, & Cacioppo, 2005; McWhirter, 1990). According to an internet search on Google Scholar with the expression "UCLA loneliness scale", the three articles that present the initial version and the two following revisions of the scale (Russell, 1996; Russell, Peplau, & Cutrona, 1980; Russell, Peplau, & Ferguson, 1978) have received 3.101 citations. For the sake of comparison with other loneliness measures, the social and emotional loneliness scale (SELSA) have received 205 citations, the loneliness rating scale (LRS) have received 42 citations, and the Differential Loneliness Scale have received 163 citations.

The UCLA assumes loneliness as a unidimensional phenomenon, but the clear and explicit conceptual and operational definitions on which its development was based could not be found in any of the articles related to the different versions of it (Russell, Peplau, &

Ferguson, 1978; Russell, Peplau, & Cutrona, 1980; Russell, 1996) which is a considerable obstacle for a clear and coherent psychometric evaluation of it. In contact with Daniel Russell by email (personal communication, September 24, 2016), the main responsible for the development and validation of the instrument, we were informed that the instrument is not based on any conceptual or operational definition of loneliness. As a consequence of this and of no specification of a time frame as a reference for participants, it is not clear whether this instrument was developed to measure a state or trait, something that has been pointed out previously (Cramer & Barry, 1999). What the authors explicitly say in the articles that validated the instrument is only that the items were derived from the report of depressed patients. Finally, although the absence of a conceptualization makes it harder to discuss the appropriateness of the items, there is evidence that the validity of the UCLA is questionable and we describe it further in a following section.

Social connectedness

Terms such as sense of belonging, belongingness, feelings of belonging, social belonging, interpersonal closeness, interpersonal belonging, social bond, social connection, and sense of connectedness are frequently used interchangeably with the term "social connectedness". In the literature of social connectedness, few formal theories have been developed and the conceptual definitions are frequently ambiguous or redundant. Generally, social connectedness can be understood as the experience that satiates the need to belong (Hutcherson, Seppala, & Gross, 2008; Kok et al., 2013), and the need to belong is understood as a strong basic motivation for having meaningful social relationships and maintaining them – in other words, a motivation for experiencing social connectedness in a meaningful and durable way.

The tautological nature of the proposed theoretical relationship between these variables is problematic for a satisfactory scientific understanding of both. One reason for that

is the fact that, in principle, other things could also satiate the need to belong other than the perception of social connectedness, such as momentarily experiencing positive mood, well-being, falling in love, or experiencing intense empathic reactions. Apparently, nothing could prevent this from happening. If the need to belong is a fundamental motivation of humans and have so many impacts in our lives, we should understand precisely what is it that satiates such a need, mainly because it is at least possible to think that experiencing social connectedness is not the only way to satiate the need to belong.

Some authors have conceptualized social connectedness as "a person's subjective sense of having close and positively experienced relationships with others in the social world" (p. 412, Seppala, Rossomando, & Doty, 2008). Lee and Robbins (1995, 1998) defined social connectedness as a mental representation of the patterns of interpersonal closeness with other people. Although this is a less vague definition than the previously described, one could argue that it is too focused only on the cognitive dimension of the experience, and not much on its emotional dimension, a characteristic that many authors emphasize as one of the main aspects of the variable (Seppala et al., 2008). Although social connectedness is commonly understood as a multidimensional construct in developmental and school psychology, composed of subtypes related to each main social sphere in the lives of children and adolescents (e.g. peer connectedness, school connectedness, family connectedness) (Hendry & Reid, 2000; Kaminski et al., 2010), it is generally conceptualized and measured as a unidimensional construct in social psychology. The same potential problem that we pointed out about loneliness also apply to social connectedness – the phenomena can be much more complex than current theories and measures assume.

Social connectedness and loneliness

It is a common implicit and even an explicit assumption in the literature that loneliness is the opposite of social connectedness (Bastian et al., 2015; Bekhet, Zauszniewski, & Nakhla,

2008; Cacioppo & Hawkley, 2009a; Cacioppo & Patrick, 2011; Epley, Akalis, Waytz, & Cacioppo, 2008; Hawkley & Cacioppo, 2010). That is, the most extreme level of loneliness is assumed to be mainly equivalent to the less extreme level of social connectedness. In that sense, social connectedness would be the psychological remedy for loneliness, and the following excerpt makes this assumption explicit: "One needs to feel connected to significant others to not feel lonely" (Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015, p. 239). Another example is the following excerpt from another article: "an exploratory factor analysis of the 20-item UCLA Loneliness Scale (an instrument that assesses degree of social connectedness)" (p. 1, Hawkley, Gu, Luo, & Cacioppo, 2012). In this last case, the authors describe the most used instrument to measure loneliness as a measure of social connectedness. In this literature, one term can commonly be used interchangeably with the other in a reversed fashion. For example, this can be observed when one refers to a lack of loneliness (e.g. social disconnectedness) (Bastian et al., 2015; Hawkley & Cacioppo, 2010), even though no explicit attempt at empirically verifying and exploring this bipolar relationship was identified.

Some argue that this assumption is just a consequence of not having a better concept to refer to the opposite of loneliness (Cacioppo & Hawkley, 2009a), but in practice most of the researchers just assume it without further precautious considerations. One extreme example of this observation is the fact that some studies have used measures of loneliness with the intent to measure in a reversed fashion social connectedness, making clear the at least implicit assumption of bipolar opposition between these phenomena (Hawkley et al., 2005, 2012; Kok, Coffey, et al., 2013). If this opposition is empirically questionable, then findings from such studies may be incurring in systematic measurement and interpretational errors. Another example of the problem that this can represent can be seen in studies that use terms such as "social disconnectedness" as meaning something different from loneliness and from the opposite of what is usually meant by social connectedness (Cornwell & Waite, 2009). In this

particular case, "social disconnectedness" was conceptualized more closely to social disengagement than to a perception of being connected to others, which is a more similar conceptualization of social connectedness in the literature (Seppala et al., 2008).

In one study, we found evidence that this assumption may not be satisfactorily justified (see Study 3 in the present dissertation). The evaluation of the opposition between the concepts will be heavily influenced by the way they are conceptualized and measured in a study, but if conceptualizations are loose they may impact in unforeseen ways the validity of such measures (Messick, 1995). We believe that this is the case regarding the UCLA Loneliness Scale, henceforth called just as UCLA. We found evidence that the content validity of the UCLA is questionable and this is probably a consequence of the lack of an explicit conceptualization underlying the instrument development. According to Lee and Robbins (1995) many definitions in the field of social psychology have in common the description of loneliness as an aversive subjective experience associated with a deficit in one's social network. These authors also emphasize that loneliness is "an affective and behavioral consequent of a lack of belongingness, which is a personality characteristic" (p. 234) and that "belongingness is a development process, while loneliness may be either an acute or chronic experience" (p.234). Newcomb (1990) proposed that perhaps "loneliness and social support can be understood as "opposite poles of a psychosocial construct of personal attachment or human connectedness" (p. 482). According to this author, social connectedness would be a higher order construct in relation to loneliness and social support.

The debate about the bipolarity between other psychological constructs may illustrate how apparently obvious opposites can prove to have more complex relationships. For example, it is intuitive to understand happiness as the affective opposite of sadness, but authors have pointed out that this opposition is questionable (Rafaeli & Revelle, 2006). These authors found different sources of evidence favorable to the conclusion that happiness and

sadness reflect separate constructs that are not bipolar, although they aren't also independent. These findings led the authors to classify the assumption of bipolarity between happy and sad as a premature consensus and that accumulating evidence indicates a more complex relationship between these constructs. We also think that it is a premature consensus to assume the opposition between loneliness and social connectedness without scrutinizing our instrument's assumptions and the theories underlying them.

Apart from our study cited before, there are relevant evidence from social neuroscience coherent with our concerns about the validity of the assumption of bipolarity. While loneliness is generally linked at the neural level to many regions associated with pain processing and stress responses, such as increased activity of the hypothalamic pituitary adrenocortical (HPA), the dorsal anterior cingulate cortex (dACC), the anterior insula, the periaqueductal gray (PAG), and the amygdala (Cacioppo, Capitanio, & Cacioppo, 2014; Eisenberger & Cole, 2012), social connectedness is associated with regions related to reward processing and empathic reactions, such as increased activity in the ventromedial prefrontal cortex (VMPFC), the ventral striatum (VS), and the septal area (Eisenberger & Cole, 2012; Hutcherson, Seppala, & Gross, 2014). Thus, not only these two feelings are associated with different patterns of neural activity and with different brain areas, but both may impact health related outcomes by different neurobiological mechanisms as some authors have proposed. For example, as Eisenberger and Cole put it:

> Although perceptions of social connection or disconnection may ultimately influence health through the same peripheral 'distributors' of social psychological experience (SNS and HPA axis), these social experiences may engage multiple, functionally distinct neural circuits in the central neural and neurobiological systems. We suggest that discrete experiences of social disconnection versus connection may be processed by separate neural systems involved in responding to harm and reward, respectively,

resulting in corresponding peripheral physiological responses that represent an integration of output from those two central neural systems (p. 1).

This neural systems dissociation does not falsify the bipolarity hypothesis necessarily, but it supports the idea that both experiences are related to different neural circuits that may impact health, cognition, and behavior by different mechanisms. One possibility derived from this conclusion is that social connectedness and loneliness might have different magnitudes of impact on different variables such as health and may cause this impact by separate neural, cognitive, and affective mechanisms. If we assume that they are simple opposites of one another as the literature has been doing, we might take it for granted and avoid the exploration of the complexity of mechanisms that might be relevant to advance the understanding of the different impacts that social connectedness and loneliness can have on different sets of phenomena.

Another relevant issue is the mental representation of these experiences, which is a very underdeveloped scientific endeavor in the field of social psychology. According to cognitive science, there are different ways in which information can be mentally represented (Thagard, 2005). Previous authors have discussed the mental representation of social connectedness and loneliness based mainly on results of post-hoc factor analysis of the UCLA loneliness scale (UCLA) (Hawkley et al., 2005, 2012). In the case of the UCLA, this approach is more problematic, as there was no explicit conceptual basis underlying its development. Secondly, we believe that drawing inferences about the structure of the mental representation of social connectedness from an instrument that measures loneliness is a questionable procedure because it assumes an inversed equivalence between the constructs that is not supported by evidence (see Study 3 of the present dissertation). Thirdly, the UCLA does not specify a specific time frame regarding how the participant should interpret the items and respond to them (Cramer & Barry, 1999). One consequence of this is that it is not determined

or inferable whether the instrument captures a trait or a state, which makes even more ambiguous the interpretation of the mental representation of social connectedness or loneliness from such an instrument. We propose that it may be more informative to investigate the mental representations of loneliness and social connectedness by comparing information derived from measures that explicitly assume and operationalize different cognitive structures. By doing this we can be more confident that our conclusions about the mental representations of these phenomena are related to the theoretical assumptions underlying the instrument instead of measurement artifacts.

The Need to Belong, the Affiliation Motive, and The Need of Relatedness

It is hard to discuss loneliness and social connectedness without including in this discussion what is usually assumed to be the basis for both experiences – the need to belong. Humans have a basic motivation to develop meaningful social relationships and maintain it, something commonly denoted as a need to belong (Baumeister & Leary, 1995; Baumeister, 2012; Cacioppo et al., 2011; Lee & Robbins, 1995). Our basic need to connect and get together is also accompanied by spontaneous and strong intergroup biases such as the in-group favoritism bias (Brewer, 1979; Anthony G. Greenwald & Pettigrew, 2014; Tajfel, Billig, Bundy, & Flament, 1971). The main and most cited model of the need to belong (Baumeister & Leary, 1995) defines its main construct in a similar way as the implicit motive of affiliation is conceptualized (McClelland, Koestner, & Weinberger, 1989).

The affiliation motive is usually understood as a disposition to desire and experience pleasure when one is connected to others (Job, Bernecker, & Dweck, 2012; McClelland et al., 1989). In both cases, the models are describing a basic motivation to value, seek, and experience social connectedness. The main difference between the implicit motives theory and the need to belong theory is that the implicit motives theory is a broader basic motivations theory in that it describes other general and basic motives observable in humans (e.g.

achievement motive). Finally, self-determination theory also proposes that the fundamental and innate psychological needs of competence, autonomy, and relatedness guide many of people's action toward more adaptive and optimal behaviors in their physical and social world (Deci & Ryan, 1985, 2000). The need of relatedness is conceptualized as a tendency "to seek attachments and experience feelings of security, belongingness, and intimacy with others" (Deci & Ryan, 2000, p. 252).

Although the specific words chosen to describe each basic need differ by theory, the main idea in any of these conceptualizations is hardly different in a level that justifies the conclusion that they are different phenomenon. As both theories are contemporary and research on these topics have developed in a considerable independent way by each proponent and their specific collaborators, one could argue that they are different expressions for the same construct, a very similar construct or even the same one. If it is true that these researchers are studying approximately the same phenomenon, findings from one of them could considerably help to accumulate knowledge and speed up the development of theoretical understanding of the phenomenon.

We think that the three theories just described all converge to emphasize the same fact that human beings are generally motivated to experience social connectedness continually along their lives, and although individual differences might exist in how strong is this motivation for a specific person, people generally seek and appreciate feeling connected. There are theories and evidence indicating that the affective nature of social connectedness and loneliness might be of greater importance than previously considered in the most prevalent conceptual proposals. For example, recent research on implicit motives indicates that basic needs such as the motives of power and affiliation can be actually dispositions to desire specific affective experiences, and that each implicit motive is related to specific affective states (Job et al., 2012; McClelland et al., 1989). For example, people with a

stronger affiliation motivation would feel more satisfaction by experiencing calmness and relaxation, no matter what the specific context is under consideration, compared to people with a stronger power motivation, whom would feel more pleasure by experiencing the affective states of strength and excitement (Job et al., 2012). This evidence supports the previously described possibility that other things could satiate the need to belong other than exclusively the feeling of having positive and meaningful relationships with other people. For example, experiencing calmness or relaxation might be one way to temporarily satiate the need to belong too or it can even be part of the mechanism that explain how positive and meaningful social interactions impact cognition and behavior.

More recently, some authors found evidence that the need to belong may be better conceptualized as a multidimensional construct (Lavigne, Vallerand, & Crevier-Braud, 2011; Neel, Kenrick, White, & Neuberg, 2016). For example, the belongingness orientation model (Lavigne et al., 2011) posits that individual differences in the need to belong can be divided into two main categories: the growth orientation is related to a greater genuine interest, openness, and commitment with other people while the deficit-reduction orientation is related to the need to feel accepted by others as a mean of feeling more secure and avoid feelings of rejection. The authors found evidence that these two dimensions of the need to belong form different patterns of relationship with other constructs such as social anxiety, loneliness, well-being, and self-esteem. Another multidimensional approach was suggested by other authors especially inspired in evolutionary psychology (Neel et al., 2016). According to these authors, different sets of adaptive problems in our evolutionary history led humans to develop different sets of fundamental social motives. These authors developed an instrument to measure individual differences in these fundamental social motives. Exploratory and confirmatory factor analysis indicated that the best factor structure to describe the items of the scale of affiliation was a three-factor structure. The three factors were labeled as integration

with groups, exclusion concern, and desire for independence. The three factors correlated modestly with one another and presented different patterns of correlation with other measures. The exclusion concern factor presented a high correlation with the scores derived from the need to belong scale ($r = .75$) (Leary, Kelly, Cottrell, & Schreindorfer, 2013) while the other factors – groups ($r = .37$) and desire for independence ($r = -.46$) – correlated only modestly with the need to belong scale. So maybe measures such as the need to belong scale, one of the most used measures in the field of social psychology (Leary et al., 2013), are more narrowly related to the dimension of exclusion concern than to some broader dimension that includes dimensions such as the desire for independence.

Six Main Unsolved Issues

There are six main interrelated issues that current conceptualizations and measures about loneliness and social connectedness do not address satisfactorily, but could readily address, and should do it in the short and long term. We describe each of them in the following sections.

Conceptualization clarity.

Most of the conceptualizations of loneliness and social connectedness are closer to the idea of "working definitions" than definitions within the context of a broad, explicit, and formal theory about the phenomena. This is far from desirable if a scientific and cumulative knowledge about these concepts is to be developed. Among many of the problems that we may incur due to concepts not carefully defined and differentiated from others, we may waste our time, resources, and come to wrong conclusions about those very things that we wanted to understand with the highest precision that we can in the first place. It is not only the clarity of the concepts in our theories that need precision, but there is also a need for coherence between the concepts we adopt in research and the concepts that the measures we use assume, just as the concepts that our experimental manipulations try to activate. The lack of conceptual

clarity has produced many undesirable ambiguities in the literature, such as widespread used instruments with poor conceptual foundations, questionable operationalization of constructs in experimental studies, and questionable research practices related to the belief of interchangeability between measures of social connectedness and loneliness (i.e. bipolarity hypothesis). Finally, the conclusions from our studies are as good as the assumptions from which the studies were based, so before worrying about the next counterintuitive experimental effect to be found or the next surprising association between variables, we should take a step back and make sure that the conceptual and measurement foundations for our studies have a coherent rationale.

Measurement.

Both social connectedness and loneliness were mainly measured by Likert-type self-report instruments until now. If we are interested in a broad, deeper, and detailed understanding of them, we should be exploring all the tools that we can use to capture these abstract and complex concepts and psychology offers many more tools than the scientists in the field of social psychology are exploring. While in social neuroscience other instruments are increasingly being used, such as functional magnetic resonance imaging (fMRI) (Eisenberger & Cole, 2012), social psychology has not advanced much of its measurement strategies for capturing the experiences of connectedness and loneliness. To the contrary, it has mainly relied on very specific strategies such as the UCLA, for example. Exploring different measurement methods and having a greater diversification of measurement strategies present many important possibilities for advancement in our field. First of all, measurement advances are frequently some of the greatest contributions that scientists can offer to their fields (A. G. Greenwald, 2012) and many of the greatest scientific developments were strongly influenced by scientists that were not satisfied with the established ways of doing research in their epoch and field. Although self-report and unidimensional measures are

certainly valuable tools, other measurement strategies could allow us to more deeply discuss issues such as the mental representation, dimensionality, and cognitive processes involved in these phenomena such as automatic and controlled processes (Hutcherson et al., 2008). Implicit, pictorial, projective measures, and objective personality tests (OPT) are some of the most important ways we believe scientists could be exploring as measurement alternatives.

Mental representation.

The discussion of the mental representation of social connectedness and loneliness is still scarce in the literature. Is the mental representation of loneliness stored and retrieved as one single broad and general evaluation of one's social relationships? Or is loneliness a complex experience that involves different mental representations associated with different interpersonal contexts? Is the mental representation of connectedness of a verbal/declarative structure, a spatial/metaphorical structure or an implicit structure? The exploration of the cognitive basis for connectedness and loneliness have not been thoroughly explored by most conceptualizations. The articles that explore to some extent the cognitive dimension of loneliness is basically restricted to positing a working definition that mentions cognitive structures or processes in loose and general ways. We believe that a stronger effort should be undertaken to describe and explore the most useful way to conceptualize the cognitive basis underlying these experiences.

Dimensionality.

A related topic to that of the mental representation of social connectedness and loneliness is the more specific issue regarding the usefulness of different dimensionality assumptions. No consensus about the most useful way to conceptualize the factor structure of social connectedness, loneliness, or the need to belong has been reached so far. Many theories and measures are available with different dimensionality assumptions (Cramer & Barry, 1999; Gierveld, 1998) but in spite of that most of the research is based on the use of the UCLA

loneliness scale. At the conceptual level, one crucial problem in the understanding of

loneliness and social connectedness as bipolar opposites is that it also implicitly assumes that

both of these variables have a unidimensional structure or, at the computational level, can be

satisfactorily synthesized as one-factor structure variables, as scales for these variables are

usually synthesized by computing a mean score or sum of the responses (Kok, Coffey, et al.,

2013; Lambert et al., 2013; Russell et al., 1980), which are also questionable psychometric

procedures according to some authors that classify such factor score computation methods as

"non-refined" and associated with lower validity and accuracy compared to refined methods

(Distefano, Zhu, & Mîndrilă, 2009). As pointed out previously, there is increasing evidence,

at least related to loneliness and the need to belong, that multidimensional approaches to the

conceptualization and measurement of these constructs might be relevant and capture

important subtleties that unidimensional approaches ignore or regard as irrelevant (Lisa Jane

Wood, 2014). The strongest evidence in favor of a multidimensional approach come from

studies cited before that show considerably different patterns of association between

dimensions of the constructs with different criterion variables.

Consciousness.

The almost exclusive use of explicit/self-report measures in the literature to capture

loneliness and social connectedness assumes that people have easy and precise access to such

subjective and abstract phenomena. Measurement procedures are as good as their assumptions

are valid (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009), and so a careful

consideration regarding the assumption of consciousness of these psychological experiences

is warranted. As has been shown for many other cognitive processes and structures, people

are not totally aware of many things about their minds and actions (Nisbett & Wilson, 1977;

Nosek, Hawkins, & Frazier, 2011). In many cases, people are aware of the consequences from

some cognitive process or situational influence, such as emotional or physiological responses, but not fully capable of perceiving and describing the antecedent processes.

For example, people diagnosed with panic disorder can be consciously aware of their extreme emotions and physiological responses, but not necessarily conscious about their thoughts, dysfunctional schemas, and the anxiety escalation that usually precedes such reactions as a panic attack (Clark & Beck, 2011). In fact, a great deal of the standard cognitive-behavioral therapy treatment that patients receive involves training on perceiving and questioning dysfunctional cognitive representations of threats and thinking patterns associated with it (Clark & Beck, 2011). In the case of loneliness, the negative reactions coming from it might frequently be conscious to the lonely, but this person's cross situational cognitive representations about how the self is related to other people or how threating social interactions usually are might not be as conscious, clear, and evident especially in the case of chronic loneliness. According to cognitive therapy theorizing (Beck & Haigh, 2014), schemas, that is, cognitive structures not usually available to consciousness about global and central issues in a person's life are central at least for the maintenance or aggravation of many psychological conditions such as mental disorders. Considering the very basic idea of what a schema is and the fact that basic schemas about the relationships between the self and interpersonal relationships might be relevant to understand the impacts that loneliness and social connectedness can have on cognition and behavior, perhaps self-report measures are far from satisfactory instruments to access this type of information. In sum, a deeper cognitive understanding of the interplay between automatic/unconscious and controlled/conscious processes involved in the experiences of loneliness and social connectedness is yet to be developed in the field of social psychology.

Need to belong: to feel connected, to avoid loneliness or something else?

In science, doubt can lead us to wonder about different types of questions than those made before that otherwise would probably not be made in the short term. By questioning the validity of the bipolarity hypothesis, one question that can emerge is the one of whether our interpersonal need is mostly related to feel connected or simply to avoid loneliness. Of course, the answer to this question can be that both things are somehow involved, but is it possible that one thing is more important than the other? Can connectedness or loneliness be a more important predictor of, for example, physical and mental health? This question is relevant for different reasons. Firstly, avoiding loneliness does not necessarily mean that one has been successful in experiencing connectedness. Even mere distraction, for example, can help people cope with a negative experience (Gross, 2013). The opposite situation tough seems less likely – feeling connected may in most cases dissolve feelings of loneliness.

But a multidimensional approach offers a broader view of the possible relationships between these experiences and we believe that it also captures important subtitles of them. If the experience of connectedness is related to different separate dimensions or domains, feeling connected in one domain do not necessarily will lead to the same result in the other domains. For example, one can feel extremely connected during a funny reunion with the best friends, but still feel deeply lonely in the domain of emotional/romantic connectedness. People may also feel strongly connected to their current romantic partners, but this may not lead to a cross situational general connectedness if connectedness with family is not being experienced recently. Another question is: can different domains of connectedness and loneliness have different levels of importance? For example, is the connectedness associated with family more impactful in a person's well-being than the connectedness associated with a romantic partner?

The Connectedness and Loneliness Model (CLM)

Considering the state of the knowledge about loneliness and social connectedness, we present here our theoretical proposal about what are these phenomena, how they are related to one another, and how they impact other variables. This proposal is not mutually exclusive regarding other accounts. To the contrary, it is to some degree coherent with many of the previous theoretical proposals, but different in important and decisive ways. This model is our attempt to offer an example of what kind of theoretical efforts could be made to better address some of the problematic and basic issues in the literature that we just described. The model had many inspirations for its development. We were especially inspired by the loneliness model of John Cacioppo and colleagues (Cacioppo et al., 2006; Cacioppo & Hawkley, 2009b) and the general cognitive model from Aaron Beck (Beck & Haigh, 2014). Although our model describes different levels of analysis relevant to the understanding of both experiences, the focus of it is at the cognitive and affective levels. A visual representation that synthesizes the main tenets of the model can be visualized in Figure 1. The details about the model are described in the next section.
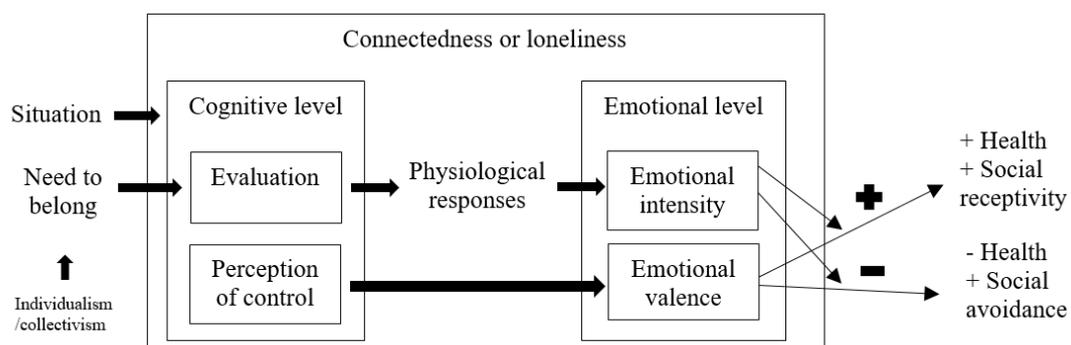
Figure 1: The connectedness and loneliness model (CLM).

Conceptual definition.

We define loneliness and social connectedness as separate and multidimensional psychological experiences each characterized by a myriad of different cognitive, emotional, and physiological characteristics. Connectedness and loneliness are not bipolar opposites, but instead they are two experiences strongly related in a more complex way. They are the two

main kinds of psychological experiences that one can have when extracts meaning from its relationships with other entities by reflecting or by type 2 processing (Evans & Stanovich, 2013) and when this dimension of a person's life is made salient by the environment or by type 1 processing. When any of these situations happens, people use their cognitive resources to evaluate whether there are satisfactory reciprocal and positive affect shared between themselves and other entities (see the "Evaluation" step in Figure 1). Instead of emphasizing the "social" of social connectedness, we believe that, in the face of existing evidence, the focus of the conceptualization should be in the "affective" part of the connectedness experience. If we understand social as basically meaning "other people" then existing evidence supports our understanding that the human mind is much more flexible and adaptable to the point that humans can feel connected in many other ways such as through other animals (i.e. pets), imaginative entities (i.e. gods, spirits) (Gebauer & Maio, 2012), inanimate objects (Epley et al., 2008; Powers, Worsham, Freeman, Wheatley, & Heatherton, 2014), and oneself (i.e. self-compassion) (Breines & Chen, 2012; Mongrain, Chin, & Shapira, 2010). What really matters in this experience is not the fact that it is derived from other people, but mainly that the person feels satisfactory positive reciprocal affect shared with some entity. The present model propose that it is not the perception of social isolation or integration that best characterize both variables (i.e. loneliness and social connectedness), but instead both might be more usefully conceptualized as experiences derived from the perception of reciprocal – in the case of connectedness - or lack of reciprocal positive affect – in the case of loneliness – shared with one or more entities. For this reason, we will prefer to use the term "connectedness" to "social connectedness" in the description of the model and suggest this use for the researchers of these topics.

Health and social receptivity/avoidance.

Figure 1 describes a series of antecedent (e.g. individualism/collectivism) and consequent processes (e.g. health) underlying the experiences of connectedness and loneliness. We describe each antecedent process of the model in the following sections. The last part of the model (right side of Figure 1) is an attempt to concisely describe the main known consequences of these experiences. In the CLM, health is a concise expression related not only to many possible specific physical health outcomes but also to mental health and well-being. Social receptivity is a broad expression encompassing prosocial tendencies such as a higher propensity to seek connectedness, to engage in social interaction, to feel empathy, and to act cooperatively. Social avoidance describes the tendency to avoid social interaction, to feel apathy toward others, to act selfishly, and to seek isolation. The CLM is mainly focused on describing the consequences of connectedness and loneliness in these psychological and health domains.

Individualism/collectivism.

Cultures shape people's mind and behavior through the composition of environments, rituals, rules, and the social interactions that people have during their lifetime (Smith et al., 2013). Culture will greatly influence the contents of these social interactions and the details about how, when, and why certain types of social interactions occur in a context. It will also expose people to explicit and implicit standards that incentivize or inhibit cognitive and behavioral patterns. One of the most relevant cultural features that will influence the experiences of connectedness and loneliness is the differentiation between collectivism/individualism (Smith et al., 2013). This will happen mainly because people in more collectivistic cultures tend to have a more interdependent self-construal compared to people from individualistic cultures, whom tend to have a more independent self-construal (Varnum, Grossmann, Kitayama, & Nisbett, 2010). This will generally lead people to be more sensitive to cues about one's current level of connectedness in the case of more

interdependent self-construal and less sensitive in the case of independent self-construal. One hypothesis that can be derived from the CLM is that people in more individualistic cultures will have a weaker need to belong while people in collectivistic cultures will have a stronger need to belong.

Need to belong.

Culture will influence not only how the self is perceived as more interdependent or independent of others but, together with the environment and genes, it will also influence many other aspects of a person's personality. Although a great variety of personality traits might have an association with experiences of connectedness and loneliness (Cacioppo & Hawkley, 2009b), the present model will focus on what may be the most directly related individual difference relevant to predict a person's pattern of connectedness and loneliness experiences: individual differences in the need to belong. Not only humans have a universal need to belong but people differ in how sensitive they are to the current satisfaction of their need to belong (Baumeister & Leary, 1995; Hofer, Busch, Raihala, Poláčková Šolcová, & Tavel, 2017; Leary et al., 2013) and greater levels of the need to belong are associated with different psychological constructs such as higher negative affect, rejection sensitivity, propensity for hurt feelings, and schizoid personality disorder symptoms (Leary et al., 2013). A higher need to belong will increase the influence of the activation of schemas about how the self is affectively perceived in relation to other entities on the physiological responses which in turn will increase the intensity of the emotional state associated with the experience of connectedness and loneliness.

The CLM assumes that the need to belong is a multidimensional individual difference related to a person's motivation to seek, value, and miss experiencing connectedness. As proposed by Pillow, Malone, and Hale (2015), the CLM assumes that the need to belong has at least two possible dimensions: a growth orientation (a motivation for developing and

maintaining satisfying relationships) and a deficit reduction orientation (a motivation to "fill a gap" inside the person and to feel accepted by others to reduce negative affect). We also conjecture that maybe the need to belong is multidimensional in other aspect and this is on the type of connectedness. Maybe people differ not only on how much they need to feel connected but they may also differ on how they need to feel connected, that is, people may be more affectively dependent on feeling connected to their families, friends, romantic partners, or some other entity. This hierarchy in the need to belong might vary across a person's lifetime but may stabilize in adulthood and be focused on the person's own family (husband/wife, children). We aim only to make a concise conjecture about this because the need to belong is a broad topic which is not the main aim of the present dissertation. We believe that this idea is worth further exploration in the future, may stimulate new studies about this topic, and new conceptualizations about the need to belong.

Cognitive level.

The experience of connectedness is usually related to the activation of functional and positive schemas about how the self is affectively perceived in relation to other entities in a situation. A high level of connectedness will usually be associated with schemas describing the self as socially integrated (i.e. "I belong here") and with a satisfactory number of potential targets with which one shares reciprocally positive affect (i.e. "I feel loved by others"). These schemas are mental representations that develop mainly throughout one's lifetime by means of people's social interactions. Positive and functional interpretations about social interactions are the main developmental antecedents of these representations underlying connectedness. As a person develops, these schemas tend to be more stable and powerful in shaping how new social information will be processed and retrieved. These schemas work as cognitive filters that influence how the person will evaluate their current situation. These evaluations or thoughts derived from the use of schemas to process new information from the environment

can activate emotional and physiological reactions that will then motivate other thoughts, feelings, and behaviors. After the schemas are activated, they shape how the evaluation of reciprocal and positive affect shared with other entities is made.

Loneliness on the other hand is cognitively characterized as being associated with the activation of dysfunctional and negative schemas about how the self is affectively perceived in relation to other entities in a situation. A high level of loneliness will usually be related to schemas describing the self as socially disintegrated (i.e. "I don't belong here") and with an unsatisfactory number of potential targets with which one shares reciprocally positive affect (i.e. "nobody likes me"). People will usually have both functional/positive and dysfunctional/negative schemas about oneself to some extent because of the diverse range of social experiences that they usually have throughout their lives, but the most commonly activated and reinforced schemas by the environment will determine how new information about social interactions and relationships will most likely be evaluated at the present. The activation of schemas can be influenced by the current situation if it makes some of the schemas more salient. This could explain a part of the variation in the experiences of connectedness and loneliness lived even by chronic lonely people.

The CLM assumes that the mental representation of connectedness and loneliness are complex and involves different schemas related to the different domains from which people extract connectedness (see the "sources of connectedness" section). Because of this, both constructs should be understood and measured as multidimensional variables. We present evidence in studies 3, 4, 5, and 6 that corroborates some of the statements made in this section.

Physiological level.

At the physiological level, the experience of connectedness will generally be associated with increased activation of reward and empathy related brain systems

(Eisenberger & Cole, 2012; Hutcherson et al., 2014; Inagaki & Eisenberger, 2013). At the chemical level, this will also mean a greater release of specific hormones and neurotransmitters. Oxytocin is the most important hormone for the experience of connectedness and its release is related to increased motivation for social bonding, sexual readiness, and different reproductive aspects (Campbell, 2010; Macdonald & Macdonald, 2010; Shen, 2015). The experience of connectedness is also usually related to greater levels of dopamine release in the dopaminergic pathways of the brain.

Loneliness is generally associated with greater neural activity in pain, threat, and stress systems (Cacioppo et al., 2014; Eisenberger & Cole, 2012). Due to the greater activity in the sympathetic nervous system in response to stress and threat, immunological and restorative processes in the body can be inhibited during this experience (Cacioppo, Cacioppo, Capitanio, & Cole, 2015). The main hormone associated with loneliness is cortisol and this relationships is stronger in the case of chronic loneliness (Cacioppo et al., 2015; Wegner, Schüler, & Budde, 2014). Cortisol regulates different processes such as blood sugar level, blood pressure, metabolism, and memory formation. Greater levels of this hormone prepare the organism to emit a fight-or-flight response to a threating situation. These neurochemical changes will be a reaction to the cognitive level and form the basis for the different emotional responses associated with the experiences of connectedness and loneliness. Whether one is experiencing loneliness or connectedness, the intensity of the emotional responses will be mediated by the intensity of physiological changes associated with the cognitive level (see Figure 1), while the valence of these emotional responses will mediate the effect of connectedness or loneliness on health-related variables and social receptivity. The physiological level was not the focus of the studies in the present dissertation and should be explored in future studies.

Emotional level.

The activation of the schemas and physiological responses by the current situation described above can lead to different emotional responses which will then impact subsequent cognition and behavior. Experiencing social connectedness will usually be associated with positive emotional states, such as joy, satisfaction, calm, relaxation, and even transcendence during extreme experiences such as those frequently observable during spiritual and religious rituals. But, paradoxically, perceiving excessive or undesirable connectedness with an entity may also lead to negative emotional states such as fear, sadness, regret, and rage, although these are less frequent emotional consequences of this experience. This is what happens, for example, when people still feel strongly connected to a previous relationship that ended up due to misunderstandings or a wrongdoing. Remembering and reliving the experience of connectedness with that other person without the intention to do so might lead to even extreme negative emotional responses, so connectedness does not necessarily lead to positive emotional states as it is usually assumed.

On the other hand, loneliness will usually be associated with negative emotional states, such as sadness, distress, apathy, self-hatred, and detachment. This happens because in many cases people experience loneliness without intentionally choosing so. In this circumstance, experiencing loneliness will usually activate dysfunctional schemas, pain/stress-related physiological responses, and negative emotional states. But a crucial antecedent that can explain a variety of loneliness and connectedness effects on health and social receptivity is the perception of control over the current experience. Perception of control over the current experience (PCCE) can be defined as the interpretation that one chose and wants to be in the current situation. When people intentionally choose to be isolated from others, an experience some named as solitude (Epley & Schroeder, 2014), functional schemas, pleasure-related physiological responses, and positive emotional states can be elicited.

For example, when a Buddhist monk intentionally isolate himself to practices a Buddhist Theravada meditation such as *metta* (Hutcherson et al., 2008) for extended periods of time, even an extreme and prolonged experience of isolation can lead to psychological growth and well-being. This is the case in most immersive meditative practices. This happens because humans are not only highly motivated to feel connectedness, but they are also motivated to feel autonomy and control over their lives (Deci & Ryan, 2000; Köllner & Schultheiss, 2014; Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). Threats to this perceived autonomy will generally be aversive whether one is currently experiencing connectedness or loneliness. When someone feel bad about their lonely current circumstance, the negative valence associated with this emotional state will be shaped by the extent to which someone perceives control over their current experience. Choosing spontaneously to be lonely such as in immersive meditative practices or watching series alone in a Saturday night can lead to positive emotional states and other positive consequences. On the other hand, experiencing connectedness that one would rather not feel, such as the one experienced while someone keeps compulsively remembering about a person that they still love but do not have a current relationship with can lead to negative emotional states and negative consequences (see Figure 1) such as the development of mental disorders. Most of the statements in this section will remain to be explored in future studies, as the studies in the present dissertation did not address them properly.

Sources of connectedness.

Different from previous conceptualizations in the literature, the CLM proposes not only that there are different sources for the experiences of connectedness and loneliness but also that there is a hierarchy of importance between these sources. There are four main sources from which people usually derive meaningful experiences of connectedness and these are their family, friends, romantic partners, or some other entity (e.g. gods, spirits, animals,

the self). There is considerable evidence described earlier showing that the connectedness or loneliness that people experience can be empirically distinct at least in these four spheres – familiar, friendship, romantic, and other entities. Reminders of the reciprocal positive affect shared with entities in at least one of these categories will temporarily activate schemas, physiological responses, and emotional processes that can initiate both the more common mild sense of connectedness or an intense sense of connectedness depending on the intensity of activation of the variables described in Figure 1. These connectedness sources are independent of one another, although they can be interrelated in different ways.

As sources of connectedness, these are also sources for the experience of loneliness when low reciprocal positive affect with entities is perceived in one or more of the sources. As separate and independent sources of connectedness, each source can be differentially related to other constructs such as health and social receptivity. Taken together, these sources can have different contributions to the overall health and adaptation of the person to the environment. People most frequently derive connectedness from their family, friends, and romantic partners, although other entities such as religious entities, animals or oneself are also an important source of connectedness in the lives of many people. The family domain is usually the most important and impactful source of connectedness from all. This results from both evolutionary and developmental reasons. Family members are the closest genetically related people to a person and probably the most supportive beings for the survival and reproduction of a person especially until adulthood. Experiencing connectedness toward them has probably rendered an evolutionary advantage compared to other sources of connectedness. Family members are also the ones from which the first experiences of connectedness are established and from whom one most frequently derive experiences of connectedness during his or her development. Children abandoned by their biological parents such as those living in orphanages do not necessarily suffer from negative outcomes in health

and social receptivity if their environment provides other supportive caretakers. Studies 5 and 6 of the present dissertation present evidence that corroborates the assumption that connectedness derived from the family is more important than the connectedness derived from the romantic and social domains.

Causal mechanisms.

Mediation.

Physiological responses will mediate the effect of the cognitive level on the emotional level. If the appropriate physiological responses are triggered by the cognitive level, a coherent pattern of emotional responses should be observed. The direction of the effects of connectedness and loneliness will be determined mainly by the valence of the emotional state accompanying the experience of connectedness or loneliness, which will work as a mediator in the CLM. One important antecedent of the valence of the emotional state is the perception of control over current experiences (PCCE) (see Figure 1). PCCE is an important antecedent for connectedness and loneliness and will considerably predict the valence of the emotional state experienced during both experiences. A higher PCCE will generally lead to a positive emotional state while a lower PCCE will generally lead to a negative emotional state. The valence of these emotional states will then mediate the effect of connectedness or loneliness on health and social receptivity. Positive emotional states will benefit health-related variables and increase social receptivity while negative emotional states will harm health-related variables and increase social avoidance.

Moderation.

The intensity of the emotional state will increase the impact that connectedness and loneliness will have on health and social receptivity by moderating the effect of the valence of the emotional state on health and social receptivity/avoidance. That is, the intensity of the

emotional state will magnify the influence of the valence of the emotional state on outcome variables regardless of the direction of this influence.

Development.

The continuous interactions between the variables described by the CLM across time can establish feedback loops between them that will help the person to better adapt to their environment or that will hinder adaptation. One possible dysfunctional outcome of this developmental process is a cross situational hypervigilance for threats (Cacioppo & Hawkley, 2009b). This bias will mainly result from the continuous activation of dysfunctional schemas describing the self as not sharing reciprocal positive affect with a satisfactory amount of entities and can increase the probability of negative overall outcomes to the person's health and social avoidance tendencies. People won't usually develop such biases but instead will develop feedback loops deriving from the activation of functional schemas that will promote social integration and well-being. People who develop mental disorders such as social anxiety, major depressive disorder, and schizoid personality disorder will probably present these biases.

Implications of the CLM For the Six Main Issues

Conceptualization clarity.

The main goal of the CLM is to offer a theoretical contribution to the conceptual clarity with which connectedness and loneliness are understood. Different from previous conceptualizations, the CLM explicitly describes connectedness and loneliness as two separate, multidimensional, and interrelated (not opposite) experiences that have specific cognitive, emotional, and physiological characteristics. These characteristics were described in the cognitive, physiological, and emotional level sections. Also, differently from previous literature, the model explicitly describes a series of antecedent and consequent processes that provides a nomological network that can support theory and measurement development of

both constructs (Cronbach & Meehl, 1955). There is certainly still room for improvement of the conceptual clarity regarding connectedness and loneliness, but the CLM provides one attempt to make this improvement.

Measurement.

By providing an explicit nomological network regarding connectedness and loneliness, the CLM can be the basis for the development of more sophisticated, model driven, and complex measures of both constructs. We believe that these measures should focus on the emotional level of the experience instead of the cognitive level as most measures focus because it is unreasonable to assume that people will have precise and actual awareness about the other processes described in the CLM. People will generally be much more aware of their emotions than of what precedes these emotions. When evaluating the emotional level of the constructs, the measures should specify the different sources/dimensions of connectedness from which people can derive their experiences and we suggest that these dimensions are the family, friends, romantic partner, animal, oneself, and religious entities.

Mental representation.

We are unaware of previous explorations about the mental representation of connectedness or loneliness that evaluated these matter beyond interpreting results from factor analysis of self-report instruments. The evidence gathered in studies 4, 5, and 6 of the present dissertation indicated that instruments assuming a verbal and declarative representation were better predictors of mental health and satisfaction with life when compared to instruments assuming a spatial and metaphorical representation (see studies 4, 5, and 6) or an implicit representation (see Study 6). We believe that the evidence gathered in these studies are initial and deserves future attention. Now it is leading to the conclusion that the mental representation of both connectedness and loneliness is usually verbal and declarative instead of metaphorical or non-declarative. This means that the use of self-report

measures may be appropriate and that other alternative measurement procedures such as pictorial or implicit measures may not contribute considerably more to predict or explain variation in variables such as health and social receptivity/avoidance beyond what is already captured by self-report measures.

Dimensionality.

The CLM assumes that connectedness and loneliness should be understood as multidimensional constructs, although the dominant approach in the field of social psychology has been to assume them as unidimensional (Cramer & Barry, 1999). Additionally, the CLM proposes that there is a hierarchy between the different dimensions of connectedness and loneliness. In this hierarchy, family is generally the most important source of connectedness from all, although the importance of each source may vary from person to person – a Buddhist monk probably will have a different hierarchy compared to a married couple with two kids. We found evidence in studies 4, 5, and 6 in the present dissertation that corroborates this distinction and reinforces the importance of family as a source of connectedness. One important implication of assuming a hierarchy between the sources of connectedness is that taking this into account might be useful to tailor more personalized interventions and, as a consequence, offer more effective interventions to the community (S. Cacioppo et al., 2015).

Consciousness.

Both type 1 and 2 processing are described in the CLM as possible mechanisms of the evaluation step of Figure 1 (see the section on the cognitive level previously). That is, people can make more automatic or controlled evaluations about how much they share positive affect with other entities and this will depend mainly of the current situation. This part of the CLM allows the conclusion that people may be unaware of these evaluations in certain situations (or maybe most situations). To further explore this issue, we investigated in Study 6 of the

present dissertation the contribution of an implicit measure of loneliness in predicting satisfaction with life. Compared to other predictors, this measure was the worst predictor of all. We also found in some of the studies that a pictorial measure of connectedness does not access the construct in a way that adds considerable explanation of variation of the criterion variables beyond what self-report measures do. Although the exploration of this issue is still scarce, the initial evidence observed here indicates that implicit processes and constructs may not be important variables for models of the understanding of connectedness and loneliness.

Need to belong: to feel connected, to avoid loneliness or something else?

From all the six main issues described here, this was the one that was less explored by the CLM and the studies described in the present dissertation. As the need to belong was not the main construct of interest, we opted to give it a secondary priority in comparison to the other issues. The evidence from Study 3 in the present dissertation pointed to the possibility that to feel connected is more important than to avoid loneliness when the need to belong is concerned. The proper systematic investigation of this question will demand new studies. We also made a conjecture in the CLM about the multidimensional nature of the need to belong. In consonance with other authors (Neel et al., 2016; Pillow et al., 2015), the CLM proposes a multidimensional approach in the conceptualization and measurement of the need to belong. We believe that the conjecture about the multidimensional nature of the need to belong regarding the sources of connectedness (family, friends, romantic partners) is innovative and deserves future exploration.

Possible Theoretical Implications

The CLM holds potential implications for the understanding of many issues in psychology, as the concepts described in the model are linked to many other phenomena other than just the ones that are the focus of the model itself (i.e. connectedness and loneliness). We will focus on describing some of the theoretical implications of the CLM for understanding

religion, spirituality, and depression. Similar analyses could also be made for other variables such as nostalgia, social phobia, dependent personality disorder or schizoid personality disorder but we will strive for conciseness by focusing only on the previously mentioned examples. The theoretical implications will involve both suggestions of interpretation of the phenomena and specific hypothesis that will illustrate how the model can stimulate innovative findings in different areas of interest.

Religion.

The CLM describes that humans have a universal and chronic need to feel that they have reciprocal affect shared with other entities and that this can be in principle derived from many other things other than just a real present person. Then one of the main reasons why religious ideas such as the common concept of a god that loves and cares about humans are so prone to be successful in different cultures throughout human history is that humans have a strong need to feel reciprocal affect that could be temporarily satiated anytime and anyplace thanks to the imagined presence of an always available human-like consciousness called god. All that humans would need to have this endless source of connectedness is the power of their imagination and cultural rituals that would stimulate this relationships with the divine.

The idea of a god or supernatural entities worried about your state of affairs and ready to offer love, support, and forgiveness, so common in different religious traditions (Boyer & Bergstrom, 2008; Bulbulia, 2004), helps to solve or at least soften one very important evolutionary problem – experiencing connectedness in a world that other people are not always available or trustworthy enough to motivate the search for social interaction with them. If the need to belong is such a powerful and biologically ingrained characteristic of our species as many authors propose (Baumeister & Leary, 1995; Job et al., 2012), then it makes sense that our amazing power of imagination could lead us to a very important and easily accessible help to deal with our need to belong. The CLM is a model that better supports this

reasoning because it assumes that connectedness is an experience that can be derived from any entity and in the religious arena what is most important for feeling connected is not simply to have a long lasting and positive relationship with the entity as other models would lead one to think, but specifically what matters is the perception of reciprocal positive affect shared with that entity. The CLM allows the prediction of the following hypothesis: The perception of reciprocal affect shared with a religious entity will be a better predictor of religion effects on health and well-being compared to religious affiliation or religiousness.

Spirituality.

A great deal of the spiritual and transcendent experiences that people have are, according to our model, an extreme state of connectedness directed to people, a supernatural entity or oneself. This would probably not apply to sheer mindfulness meditation, but would apply especially to many other spiritual experiences that involve self-knowledge or self-reflection. Good examples of what we are describing here are the meditations cultivated in the Theravada Buddhist tradition, such as loving-kindness and compassion meditations (Kok, Waugh, & Fredrickson, 2013; Shonin, Van Gordon, Slade, & Griffiths, 2013). Self-compassion meditation (Barnard & Curry, 2011) is an activity that can lead to strong connectedness associated with intense positive emotional states toward oneself, an observation that reinforces our proposal of using the term "connectedness" instead of "social connectedness", as this experience do not rely only on other people necessarily. One hypothesis that can be derived from the CLM is the following: perceptions of shared reciprocal affect with entities such as oneself can have similar effects on other variables (i.e. health and social receptivity) as the perception associated with entities such as other people.

Depression.

Isolation is commonly seem as one common characteristic of depression (Cacioppo et al., 2011). Although the association between isolation and depression has been identified in

some studies, their goal was usually to use this association as an evidence corroborating the fact that they are different constructs. The CLM can be used to derive new hypotheses about the relationship between isolation and depression. If we assume that the perception of shared affect with entities is the core process in connectedness and loneliness experiences as the CLM proposes, one possibility is that this process plays an important role in the emergence or maintenance of depressive symptoms. This could happen because intense or frequent experiences of loneliness involves the reinforcement of dysfunctional schemas about how the self is perceived in terms of reciprocal affect with entities.

Very intense or frequent experiences such as, respectively, the death of a loved one or continuous bullying could suddenly or incrementally increase the probability that dysfunctional schemas will be used as the standard cognitive filter to process new social information possibly initiating a downward process of depressive symptoms establishment. A similar logic could happen for the maintenance of depressive symptoms but both possibilities would equally demand empirical evidence to have their validity properly judged. This rationale allows the formulation of the following hypotheses: activating the concept that oneself shares affect with many entities will decrease depressive symptoms; self-compassion meditation will decrease depressive symptoms by means of increasing the perception of reciprocal affect toward oneself; loving-kindness meditation will decrease depressive symptoms by means of increasing the perception of reciprocal affect with other living beings.

Limitations of the CLM

A model that explains everything will probably be useless in science. This is so because a model that explains everything about a subject is probably going to be flexible enough to accommodate any kind of observation, rendering it as an unfalsifiable model. As an unfalsifiable model can never be shown to be wrong, we can never know if it is true too

because any observation would yield an optimistic conclusion about it. Considering this, any falsifiable model must have many limitations and this is the case of the CLM.

The main limitation of the CLM is that many of our theoretical proposals and derived hypothesis still lack empirical corroboration. Although many of the ideas described before are warranted by previous studies or at least coherent with them, many of them will demand future exploration. Although we recognize this as a present limitation, we believe that theoretical proposals do not demand mandatorily ahead of publication favorable evidence if the proposal is scientifically plausible, coherent with basic scientific principles and current knowledge. Additionally, one of the most interesting features of the CLM is its capability of generating innovative hypothesis about a wide range of topics of interest to different psychological disciplines. The hypothesis that we described here as practical examples of the model's generative capability would not be innovative if there were already favorable evidence for them in the literature, so for a logical reason these hypotheses should lack empirical corroboration in the present.

We assume like Cronbach and Meehl (1955) that "to validate a claim that a test measures a construct, a nomological net surrounding the concept must exist" (p. 291). Most of the connectedness and loneliness measures developed until now were not supported by a previously established and explicit nomological net which makes it harder to evaluate the validity of these measures. The CLM is a tool that proposes a nomological net to understand and predict different patterns of relationships between psychological constructs central to the workings of connectedness and loneliness. It is our desire that the CLM can be further empirically explored by other researchers, used to generate innovative research in the field of social psychology, and that it stimulates a greater attention to the conceptual foundations underlying the instruments currently being used for measurement and the experimental manipulations in the field.

Final Remark About the Following Studies in the Present Dissertation

The investigation of all the possible relationships, theoretical assumptions, and predictions derived from the CLM is beyond the goal of the studies reported in the present dissertation. This is not a viable goal because of many reasons. The first one is that there are few available instruments to measure many of the crucial variables described in the model and so the development or adaptation of measures, experimental manipulations, and initial estimates of association between the constructs are necessary initial steps before more sophisticated aspects of the model can be considered as possible studies to be conducted.

All the studies reported in the present dissertation contributed somehow to the development or adaptation of instruments for the future exploration of the CLM. The CLM is a complex model that allows the investigations of many research questions in different levels of analysis. Considering that the period for the conduction of the studies reported here was three years, it would be unreasonable to imagine that the five empirical studies that we conduced could exhaust the richness of research possibilities derived from the model. The studies that are described in the rest of the dissertation were focused on initially exploring different aspects of the CLM and producing tools that would allow this exploration in the future.

Study 2: Psychometric Properties of the Adapted Version of the Social Connectedness Scale to Brazil

Feeling connected to others usually feels good and feeling socially isolated is an aversive psychological experience to most people (Baumeister & Leary, 1995). The experience of social connectedness has been shown to affect many different psychological and behavioral phenomena, such as subjective well-being, happiness, prosocial responses, and emotions (Kok, Coffey, et al., 2013; Lee et al., 2008; Lee & Robbins, 1998; Leiberg et al., 2011; Mauss et al., 2011). One problematic issue surrounding the scientific study of social connectedness until recently was the dearth of measures with concrete and accumulated evidence of psychometric qualities (Lambert et al., 2013). This difficulty can lead studies about social connectedness to be less comparable, as the measurement issue is almost never held constant among the studies. More than that, in the case of Brazilian psychology, there is no psychological measure of social connectedness available for scientists to investigate it. The goal of the present article was to translate and adapt one social connectedness scale (Lambert et al., 2013) to Portuguese and evaluate its psychometric properties.

Another issue in this field of social psychology further discussed elsewhere (see Study 1 in the present dissertation) is that the theory underlying social connectedness is still unsatisfactory from a scientific point of view. Many different concepts are evocated when one refers to this experience, such as "sense of belonging", "belongingness", and "sense of connectedness" to name a few. Even though not even a word or a set of words have been chosen by the community to discuss the topic, the conceptual definitions of it are usually not related to a formal theory about the phenomenon. One of the most influential definitions of social connectedness was presented by Lee and Robbins: a subjective sense of connection with one's social world (Lee & Robbins, 1995). But stating that social connectedness is a subjective sense of connection with others is not helpful in providing a clear and non-

redundant description of what constitutes such a complex phenomenon. This theoretical issue has probably impacted the problematic methodological issues in this area of research. A novel theoretical proposal described in the present dissertation (see Study 1), the connectedness and loneliness model (CLM), is a promising research avenue for the improvement of this area, but it is not possible to explore this model in our culture without measures that can allow us to capture such constructs.

To explore social connectedness, its measurements, the connectedness and loneliness model (CLM) (see Study 1 in the present dissertation), and conceptualizations in Brazil, we first need a measure of it. One of the first measures of social connectedness to be developed in psychology was the social connectedness scale developed by Lee and Robbins (1995) and later revised (Lee, Draper, & Lee, 2001). The original scale is composed of 8 items and all of them were negatively worded, that is, indicated a lack of social connectedness. Participants should choose one of six response options varying from 1= strongly agree to 6 = strongly disagree. The revised social connectedness scale, which is a revision of the social connectedness scale, is composed of 20 items: 10 positively worded and 10 negatively worded. The scale presented acceptable reliability ($\alpha = .94$), significant correlations with the UCLA loneliness scale ($r = -.80$), membership ($r = .49$), private ($r = .42$), and public self-esteem ($r = .39$) as evidence of discriminant validity. They also found statistically significant correlations of the scale with independent self-construal ($r = .37$), social avoidance ($r = -.57$) and social distress ($r = -.55$). One of the problems with that measure is the fact that it was based on an operational definition of social connectedness that is mentioned in the article but is not explicitly available. It is difficult to judge the appropriateness of the items and to critically evaluate the instrument without this information.

A more recent measure of social connectedness (SCS) was developed by Lambert et al. (2013). According to these authors, it captures the subjective experience of belonging, that

is, a sense of having positive and meaningful relationships. The scale is composed of seven

items and two items are negatively worded. Participants must choose one of five response

options varying from completely agree to completely disagree. The scale presented acceptable

evidence of reliability ($\alpha = .81$). The authors also report a significant correlation of the SCS

with the UCLA loneliness scale ($r = -.54$) as evidence of discriminant validity and a

correlation with self-esteem ($r = .64$) as evidence of convergent validity.

Both social connectedness scales have similar item formats, response scales, and

favorable evidence of their psychometric properties. The fact that the scale from Lambert et

al. (2013) is more recent, shorter, mainly composed of positively worded items, which makes

the instrument less ambiguous to be understood by participants and interpreted by researchers,

and explicitly describes the conceptual definition upon which the instrument was developed

led us to the decision of adapting it instead of the scale from Lee and Robbins (1995). The

definition underlying the scale is especially important for us because many terms used in the

literature such as *belong* have no direct, coherent, and equivalent literal translation in

Portuguese. In such a case, the definition is more important for the adaptation because it will

guide the judgment of the appropriateness of the many likely adaptations that will be

necessary during the process. In the following sections, we report how the translation and

adaptation processes were operationalized and then we present evidence of the psychometric

properties of the measure.

Method

Participants.

In the sample of 222 participants the mean age was 33.6 years ($SD = 13.41$) and most

of the participants were woman (N = 175). The sample was recruited by sending emails to an

email list and through divulgation in social networks. Due to a technical failure, the sex of one

participant wasn't registered. Most of the participants were religiously affiliated with

Spiritism (N = 49), Catholicism (N = 41), to a religion that was not mentioned (N = 31) or no religion (N = 50) (Agnosticism: 19, Buddhism: 13, Protestant: 7, Atheism: 6, Afro-Brazilian religions: 4, Jewish: 2).

The initial estimation of the sample size was made by using the pwr package (Champely, 2012) of the R Statistical Package (R Core Team, 2017). To obtain a power of .80 with an alpha value of .05 and at least an expected low effect size (.20) for a correlation test, 194 participants would be a minimal sample size. We adopted a conservative low effect size estimate in the face of no previous meta-analytic estimate of it in Brazil or other country. The total sample was obtained by aggregating three different datasets with the same variables in three different moments of data collection. To verify if the participants from each database differed considerably regarding the main dependent measures, a MANOVA was conducted with dataset as the factor and the aggregated indexes of social connectedness, positive affect and negative affect as the dependent variables. No statistically significant difference was identified (all ps >.05) and all of the effect sizes were low (all η_p^2 <.027)

Measures and materials.

We adapted a Portuguese version of the social connectedness scale (SCS) (see Appendix 1). It is composed of seven items developed by Lambert et al. (2013). According to these authors, it captures the subjective experience of belonging. The scale was associated to a five-point concordance Likert scale, varying from "*discordo totalmente*" (completely disagree) to "*concordo totalmente*" (completely agree) (i.e. "I feel like there are many people with whom I belong", "I really feel accepted by others in my life"). By computing the Cronbach's Alpha estimate of reliability, we observed that the SCS exhibited an acceptable level of reliability (α = .78, 95% CI [.71, .85]), with a similar value to the one reported by the original authors.

Two researchers in the field of social psychology that fluently speak Portuguese and English were involved in the application of the back-translation method (Cha, Kim, & Erlen, 2007). One of them made an initial translation and the other one back-translated the translated version. The back-translated version was compared with the original one for comparison and adjustments. A professional translator with fluency in Portuguese and English also translated the instrument. Both the back translation of the researcher and the translation of the professional translator were used as comparisons to seek for improvements.

A main difficulty of the adaptation process occurred because the word "belong" doesn't have a clear and unambiguous correspondent in the Portuguese language. The most literal translation of this word would be "*pertencer*" (verb) or "*pertencimento*" (noun), which are poorly used words in ordinary language and even less used to refer to the subjective experience of having positive and meaningful relationships. A word that is much more used in ordinary language to refer to this kind of experience is "*vínculo*" and "*vínculo afetivo*" – something like, respectively, "bond" and "affective bond" in English. We found convergent evidence for this translation in articles written in Portuguese related to the self-determination theory (Deci & Ryan, 2000), which also have translated the need of relatedness proposed by this theory as the need of "*vínculo social*" – something similar to "social bond" in English (Appel-Silva, Wendt, Argimon, Iracema, & Argimon, 2010). Some authors even argue that the need to belong and the need of relatedness describe very similar or almost equivalent psychological constructs (see Study 1 of the present dissertation), and so we consider this comparison of translations to be appropriate. Another convergent evidence for this translation comes from the Portuguese translation (Cacioppo & Patrick, 2011) of a main book on the subject of social connectedness and loneliness (Cacioppo & Patrick, 2008). Social connectedness/social connection was translated in the book as "*vínculo social*".

But "*vínculo social*" is not a common expression in ordinary language. On the other hand, "*vínculo*" and "*vínculo afetivo*" are very commonly used expressions in ordinary language to express or describe a feeling of connection and closeness to another person or group. For example, the expression "*vínculo terapêutico*" (therapeutic bond), which is a common expression in clinical psychology, refers to the affective bond between a patient and its psychotherapist. Considering these reasons, we usually translated social connectedness as some variation of "*vínculo afetivo*" in the items. We argue that the use of "*vínculo afetivo*" is preferable to "*vínculo social*" in the items because it is an expression commonly used in ordinary language and so less ambiguous in meaning.

To further evaluate the validity of the social connectedness scale, we also used the Portuguese version (Carvalho et al., 2013) of the PANAS (Watson, Clark, & Tellegen, 1988) (see Appendix 2). The relationship between these measures would be considered a source of evidence of validity, as social connectedness has been shown to have a moderate to large correlation with affect and emotions in previous studies (Gray, Ishii, & Ambady, 2011; Kok, Coffey, et al., 2013; Mauss et al., 2011). The scale is composed of 19 items associated with a frequency scale of response varying from "never" to "always". An exploratory factor analysis assuming the two factor-structure previously reported in the literature indicated a good fit (R^2 = .90; RMSEA = .09, 90% CI [.08, .10]). The factor loadings varied from .47 to .80 and the Tucker Lewis Index of factoring reliability was equal to 0.85. Two factor scores were computed using the Bartlett scores method – the positive and the negative affect scores. Both the positive (α = .88; ω = .92) and negative (α = .88; ω = .91) scores exhibited acceptable levels of reliability.

Participant's religiosity was also measured by means of the Portuguese version (Moreira-Almeida, Peres, Aloe, Lotufo Neto, & Koenig, 2008) of the Duke university religion index (DURREL) (Koenig & Büssing, 2010). The inclusion of this measure is based on the

previous evidence that religious people can be more socially connected than non-religious people (Ritter, Preston, & Hernandez, 2013). The level of association between the scores from the SCS and the scores from the DURREL could indicate evidence of validity of the SCS. This is a five-item scale the captures people's commitment to rituals and beliefs related to a religious doctrine. A parallel analysis indicated the extraction of one factor. An exploratory factor analysis assuming one factor and adopting principal axis factoring as the extraction method indicated a reasonable fit of the data. Factor loadings varied from .53 to .76 ($R^2 = .82$).

As an additional way of testing the validity of the social connectedness scale, we included in the study two variations of a measure of Overlap of Self, Ingroup, and Outgroup (OSIO) (Schubert & Otten, 2002) (see Appendix 3), which is a measure of how the self is perceived by someone in the intergroup realm. The first version, called in-group OSIO from now on, asked participants to choose one picture among seven options that best described how close they were to their parents and close friends. The seven pictures exhibited two circles that were increasingly close until they started to physically overlap and finally one circle was entirely inside the other one. The circle in the left represented the "self" and it was smaller than the circle in the right that represented "parents and close friends". The second version, called out-group OSIO from now on, was very like the first one. The only difference was that instead of "parents and close friends" being the label for the bigger circle in the right, the out-group OSIO had "unknown people" as the label.

Our reasoning was that the in-group OSIO would have a medium to large positive association with the social connectedness index as this version is a measure of how close people perceive themselves to the likely most significant in-group that people usually have. That is, friends and family. We also expected a low to medium positive association of the out-group OSIO with social connectedness as this version measures how close people perceive

themselves to a vaguer and less likely target of strong social connectedness. Yet people with extreme and generalized social connectedness will probably have higher scores in both the out-group OSIO and the social connectedness scale as people extremely disconnected will probably have lower scores in both measures. The comparison of the association between these OSIO versions with social connectedness can also help to clarify what exactly is the social connectedness scale measuring, as the target of focus present in the items varies considerably along the items (ranging from the "family" to "others"). Although the social connectedness scale was meant to be a measure of broad perception in the realm of interpersonal relationships, this comparison might add to our understanding of how broad is the perception captured by the instrument. Finally, a socio-demographic questionnaire was used to measure participant's sex, age, and religious affiliation.

Procedure.

The research was implemented in the internet by means of the software EFS Survey ("EFS survey," 2014). Participants were initially presented with an informed consent form. If participants agreed with the form and explicitly indicated that by clicking in a digital button, they were directed to answer the social connectedness scale, then PANAS, the OSIO versions, and finally a socio-demographic questionnaire. After this, participants were thanked and an email for contact was made available in the final page.

Data analysis.

Statistical analyses were performed using the R language and computational environment (R Core Team, 2017). To produce evidence of validity, we first analyzed the distribution of the main variables (i.e. social connectedness, positive affect, negative affect, OSIO) to define the statistical techniques that would be most appropriate. Both the Shapiro-Wilk test, histograms, values of kurtosis, and skewness indicated that the main variables generally deviated considerably from a normal distribution. This is not surprising, as chronic

loneliness is generally not the main pattern in different populations and cultures, which makes it a variable that usually has positively skewed distributions despite its growing trend (Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015). Considering this we used Spearman's *rho* to estimate the association between the scores. The dataset did not contain any missing data (the software did not allow the participant to proceed to the next page of the research if any item was left unanswered).

Results

A parallel analysis indicated that four factors could be extracted to aggregate the answers to the items of the scale. But while the eigenvalue for the first factor was larger than 2.5, the eigenvalue for the second factor was close to .5 and both the eigenvalues for the third and fourth factors are close to zero. A dichotomist criterion for this analysis does not seem reasonable given that little additional variance is explained by the inclusion of other factors, so we assumed a one-factor structure for the factor analysis. An exploratory factor analysis adopting the principal axis factoring extraction method indicated a good fit ($R^2 = .81$; RMSEA = .15, 90% CI [.12, .18]). The factor loadings varied from .47 to .75 and the Tucker Lewis Index of factoring reliability was equal to 0.74. The factor score was computed using the Bartlett scores method (Distefano et al., 2009). The reliability of the score was acceptable ($\alpha = .78$; $\omega = .86$).

All the 95% confidence intervals (CI) presented in Table 1 were calculated by bootstrapping with 1.000 replicates using the RVAideMemoire package (Hervé, 2017). The association between the main variables and the corresponding confidence intervals can be visualized in Table 1. Social connectedness (SCS) was significantly and positively associated with positive affect while significantly and negatively associated with negative affect. Both of the coefficients were statistically significant, represented small to medium magnitudes of association (J. Cohen, 1988), and the confidence intervals did not include zero. The

association between positive and negative affect was small, not statistically significant, and the confidence intervals included zero. We also found evidence of a positive association both the in-group OSIO and the out-group OSIO with social connectedness. The in-group OSIO and the out-group OSIO presented a statistically significant positive association.

Table 1

Associations between the main variables with confidence intervals

Variable	1	2	3	4	5
1. In-group OSIO					
2. Out-group OSIO	.36** [.24, .47]				
3. SCS	.48** [.36, .59]	.30** [.17, .41]			
4. Negative	-.04 [-.17, .09]	-.05 [-.18, .08]	-.23** [-.36, -.11]		
5. Positive	.23** [.10, .35]	.15* [.02, .27]	.36** [.23, .47]	.02 [-.12, .16]	
6. Religiosity	-.15* [-.28, -.02]	-.13* [-.26, -.00]	-.18** [-.32, -.05]	.13 [-.01, .25]	-.18** [-.30, -.05]

Note. * indicates $p < .05$; ** indicates $p < .01$. Values in square brackets indicate the 95% confidence interval for each association. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014).

The magnitudes ranged from medium to large associations and the confidence intervals did not include zero. Religiosity was negatively associated with social connectedness. This association was small, statistically significant, and the confidence intervals did not include zero.

Discussion

In the face of a scarcity of tools to measure and investigate social connectedness in Brazil, the goal of Study 1 was to translate, adapt, and evaluate the psychometric properties of the social connectedness scale (Lambert et al., 2013). We could reach this goal and the evidence described here indicates that the measure exhibits acceptable levels of both reliability and validity. We observed evidence for validity based on other variables (i.e. affect, self-categorization). The evidence based on the internal consistency of the instrument was also acceptable. The evidence from the parallel analysis and the factor analysis evidence converged to a one factor solution as a reasonable factor solution and the theoretical relationships previously predicted with the other variables were all corroborated, except for the relationships with religiosity.

Social connectedness is known to be positively associated with well-being, happiness, and positive mood (Cwir, Carr, Walton, & Spencer, 2011; Lee et al., 2008; Mogilner, 2010; Seppala et al., 2008). The relationship between social connectedness and positive/negative mood identified in our study is coherent with such a literature and is supporting the validity of the adapted version. The evidence of association between the two versions of the OSIO and social connectedness also reinforces the validity of the measure. We identified a large association between the in-group OSIO and social connectedness. This makes sense given that the in-group OSIO requires that participants indicate how close they feel to their relatives and close friends which are also usually the people to whom a person is more socially connected. The fact that the association between social connectedness and the out-group OSIO was considerably smaller as we predicted, but still of a medium size, gives us more confidence on the validity of the SCS. The reason for it is that in the out-group OSIO people are asked to estimate how close they perceive themselves toward unknown people which will usually be people with whom one tends to feel less intense social connectedness.

The negative association between religiosity and social connectedness is contradictory to what has been observed in a previous study (Ritter et al., 2013). The study indicated among other things that more religious people were more socially connected. Many factors might explain this divergence. First, the way social connectedness was measured in this study is completely different from the way we measured social connectedness in our own study. The researchers analyzed the contents of many tweets on Twitter to infer participant's levels of social connectedness. This different approach might capture a different facet of the phenomenon, but the exact difference between what was measured in that study in comparison to ours deserves a more extensive empirical and theoretical exploration that goes beyond the goal of the present study. Another factor worth of mentioning is one particularity of our sample. The distribution of religiosity exhibited in a histogram was highly positively skewed and the median was below the mean. Most people in the world are religious (Bloom, 2012) and because of that our sample might be too different from the samples of other studies to be easily compared. Nevertheless, the exploration of the relationship between religiosity and social connectedness is still not extensive in the literature, and so our findings might be revealing a pattern that deserves further exploration.

Study 1 had many limitations. A bigger sample would be preferable to reach more conclusive evaluations of the quality of the measure. Despite it, this represents a limitation and not a failure that invalidate our conclusions. One possible criterion for justifying sample size was used – power analysis – and our final sample was bigger than the one estimated by the power analysis. Our evaluation of the validity of the measure would also be greatly enriched if we planned to include a test of validity related to external variables. This would entail measuring variables that social connectedness is already known to predict well, such as well-being, health, and mental health (Eisenberger & Cole, 2012; Seppala et al., 2008).

One limitation that is not directly related only to our measure, but to self-report measures in general, is that we assume that people have an easy, reliable access and ability to report their perception about social connectedness when they are asked about it in a self-report measure. The extent to which people are usually consciously aware of things like that demands evidence (Nisbett & Wilson, 1977). In that sense, although we argue that there is evidence in favor of the validity of the social connectedness scale, we believe that the inherent limitation of being a self-report measure demands the exploration of other measurement strategies. In that sense, it would be interesting to compare the predictive power of the social connectedness scale with the OSIO versions that we used.

Another possibility is the development of implicit measures about social connectedness, which are meant to capture constructs usually unconscious or unavailable to the individuals (Nosek et al., 2011; Petty, Fazio, & Briñol, 2009). We have not identified any attempt to explore this possibility in the literature. Comparing the predictive power of these measurement strategies might produce evidence in favor of one type. It can also lead us to the conclusion that their predictive power is not so different or that they are complementary in explaining the variance of another variable. Both conclusions would be valuable contributions to our understanding of the measurement and theorization of social connectedness and so future research should explore alternative measurement strategies too. While we suggest these venues of research for the future, we believe that the social connectedness scale can be a useful instrument to explore social connectedness in Brazil and the evidence reported here attests to its psychometric robustness.

Study 3: Is Loneliness the Opposite of Social Connectedness?

Presently, we know that having positive and lasting relationships with others may have a great impact on people's cognition and behavior. Loneliness, for example, is a phenomenon that continuously has been shown to be a major health risk factor (J. T. Cacioppo & Hawkley, 2009b; J. T. Cacioppo et al., 2011; Hawkley & Cacioppo, 2010; Masi, Chen, Hawkley, & Cacioppo, 2011). On the other side, studies about social connectedness indicate that experiencing it may have many positive outcomes, such as increased happiness, well-being, positive emotions, empathic abilities, and prosocial responses (Kok, Coffey, et al., 2013; Lee et al., 2008; Lee & Robbins, 1998; Leiberg et al., 2011; Mauss et al., 2011). Although we are accumulating a great amount of data about the importance of both phenomena, the conceptual and operational clarity with which we approach their measurement and investigation is overly problematic. The goal of the present research is to explore if social connectedness and loneliness are opposites and to describe the relationships between social connectedness, loneliness, and the need to belong.

Social Connectedness and Loneliness

It is usually assumed in the literature that social connectedness is experienced when one satiates the need to belong, and that a failure to satiate the need to belong results invariably in loneliness. In that sense, social connectedness is usually understood as a bipolar opposite of loneliness, that is, one experience is the proximately opposite outcome of the other as a result of satisfying or not the need to belong (Bekhet et al., 2008; Cacioppo & Hawkley, 2009a; Cacioppo & Patrick, 2011; Epley et al., 2008; Hawkley & Cacioppo, 2010).

Research on loneliness often conceptualize it as a perception of social isolation or as a "distressing feeling that accompanies the perception that one's social needs are not being met by the quantity or especially the quality of one's social relationships" (Hawkley & Cacioppo, 2010, p. 218). On the other hand, social connectedness can be conceptualized as a subjective

sense of connection with one's social world (Lee & Robbins, 1995). Finally, the need to belong is understood as a universal basic motivation for having meaningful and positive social relationships (Baumeister & Leary, 1995). While it may be intuitive to assume that social connectedness is the opposite of loneliness and that both experiences are inevitable outcomes of satisfying or not the need to belong, direct and systematic research testing these relationship assumptions was not identified in the literature. In the case of the opposition between social connectedness and loneliness, there are reasons to believe that this may not be such a simple and straightforward relationship as usually assumed.

At the theoretical level, one reason is that both variables are usually conceptualized and measured as constructs composed of only one dimension, despite the evidence that, for example, loneliness can be reasonably understood as a construct composed of two or three dimensions which relate to other variables in comparatively different ways (DiTommaso & Spinner, 1993, 1997; van Baarsen, Snijders, Smit, & van Duijn, 2001; Weiss, 1973). As it is the case of many other complex psychological variables, such as empathy for example (Davis, 1983), it might be useful to conceptualize these phenomena as multidimensional constructs so we do not oversimplify their representation in our scientific theories (Cramer & Barry, 1999). At the empirical level, the few studies that have verified this relationship had the main aim of producing evidence of divergent validity and led to inconsistent findings regarding this assumption ($r = -.54$, Lambert et al., 2013; $r = -.80$, Lee, Draper, & Lee, 2001). For example, a Pearson product-moment correlation coefficient of .54 is usually considered a medium size correlation score in psychology, but it is important to emphasize that in this case these measures share only 29% of their variances. This leaves 71% of their variances unexplained, which can lead us to the conclusion that interpreting results obtained with a measure of social connectedness as an inversed measure of loneliness or vice-versa due to the fact that they are

supposedly opposites can be a questionable decision – and many studies have done such a thing in the field (Hawkley et al., 2005, 2012; Kok, Coffey, et al., 2013).

A great part of the knowledge produced about loneliness relies on the use of the revised version of the UCLA loneliness scale, henceforth called simply as UCLA (Cramer & Barry, 1999; Russell, 1996). The UCLA was initially developed (Russell et al., 1978) based on a selection of items from a previous unpublished instrument (Sisenwein, 1964) and then revised twice (Russell, 1996; Russell et al., 1980). There was no explicit conceptual or operational definition of loneliness upon which this instrument was initially developed. At least, this is not described in the first paper and neither in the papers describing the revisions. Psychologist Dan Russell, the main responsible for the development and validation of the UCLA, was also contacted by email and confirmed this information (personal communication, September 24, 2016). We also could not access the doctorate dissertation upon which the initial development of the UCLA was based (Sisenwein, 1964). Despite accumulating a great amount of favorable evidence regarding its reliability and validity throughout the years, the main critique that it has received is related to the proper dimensionality of loneliness (Cramer & Barry, 1999).

We believe this instrument deserves more criticism. Firstly, it is highly problematic to develop an instrument that does not assume a conceptual definition of the phenomenon. This is problematic mainly because the interpretation of the scores derived from such an instrument is much more ambiguous and unclear. Another issue is that it is much harder to draw conceptual boundaries for what kind of contents should be included or not in the items of such an instrument and this is a particularly problematic issue in the case of the UCLA. Many items in the instrument have contents that are not directly related to any aspect of the most common conceptual definitions of loneliness. Instead, they are related to other closely related but distinct phenomena. For example, the content of two items (9 and 17) are related

to shyness/extroversion (i.e. "How often do you feel shy?"; "How often do you feel outgoing and friendly?"), a trait that although previously documented to be correlated to loneliness (Cacioppo & Hawkley, 2009a) is certainly not only a different construct from loneliness but a different kind of construct too, as it is usually considered to be an individual difference while loneliness is usually considered to be a feeling. More importantly, four items (1, 5, 6, and 10) in the UCLA are related to social connectedness (i.e. "How often do you feel that you are "in tune" with the people around you?"; "How often do you feel part of a group of friends?"; "How often do you feel that you have a lot in common with the people around you?"; "How often do you feel close to people?") and other five (3, 15, 16, 19, and 20) are related to social support (i.e. "How often do you feel that there is no one you can turn to?"; " How often do you feel you can find companionship when you want it?"; "How often do you feel that there are people who really understand you?"; "How often do you feel that there are people you can talk to?"; "How often do you feel that there are people you can turn to?").

In sum, more than half of the items of the most used measure of loneliness in the field of social psychology have contents that are not directly related to loneliness itself regardless of the conceptual definition that one considers. This should be regarded as highly problematic in the literature but instead what we identify is the widespread use of that instrument without any consideration about these problems that we are pointing out here. The interpretation of scores generated from this measure is usually made as if the scores reflected basically unidimensional loneliness plus measurement error, a theoretical assumption that is likely to be unjustified considering the item analysis that we just described. Even if the authors had a conceptual definition upon which they had based the development of the instrument we think that proposing a definition of loneliness that is so broad to the point that it includes such constructs as social support, social connectedness, and shyness/introversion/extroversion would be an unlikely theoretical proposal conflating many different types of constructs and it

would also be a much more complex construct than the unidimensional loneliness that is usually interpreted from the instrument. The fact that the items directly related to social connectedness, social support, and shyness/introversion/extroversion compose the scale may incur not only on imprecision and lack of clarity for interpretation, but it may also artificially inflate the associations of the UCLA score with other measures, as these constructs are strong predictors of different variables such as well-being and physical health. In sum, there are many reasons to think that the interpretation of scores derived from the UCLA is much more ambiguous and unclear than previously considered, especially when researchers calculate one score to represent the construct, which is usually the case.

The present study will enable us to evaluate the dimensionality of the UCLA loneliness scale and to describe its relationship with scores from the social connectedness scale (SCS). As presented in Study 1 of the present dissertation, dimensionality is one of the main unsolved issues in this literature and an important aspect developed in the connectedness and loneliness model (CLM). As no study has evaluated the relationship between these variables in Brazil, it is preferable to engage in such a study so as to have a first estimate of how these variables relate to each other in this specific cultural environment (Smith et al., 2013). Although the evidence and theory suggests that the need to belong is a universal feature of humans across cultures, the specific psychological processes and structures underlying such experiences are probably influenced by cultural variations (Smith et al., 2013). This is also an important first step considering the evidence that experiences of interpersonal acceptance and rejection can vary across cultures (Garris, Ohbuchi, Oikawa, & Harris, 2010), and that the sense of connectedness can be different in certain aspects in Eastern cultures compared to Western cultures (Markus et al., 1991).

By assuming the previously described bipolar relationship between social connectedness and loneliness, we could at least expect to observe a strong negative

correlation between measures of these variables in any given study. It is theoretically assumed in the field of social psychology that social connectedness is strongly and inversely correlated with loneliness in such a way that it is assumed to be justifiable using the measure of one construct to measure the other in an inversed way. From this assumption, it is argued that we could reasonably expect an r value of at least -.8 in the present research. This value would indicate that these variables share 64% of their variances, that is, more than half of their variability. As others have pointed out, a mere estimation of association is a weak evidence for testing the opposition between psychological concepts (Rafaeli & Revelle, 2006). For this reason, the bipolarity hypothesis between social connectedness and loneliness was explored by using other statistical techniques such as factor analysis, multidimensional scaling, and the angular separation between scores.

By measuring the need to belong, we could also test how both variables relate to its supposed underlying basic motivation. Previous evidence indicate that the correlation is usually low (Leary et al., 2013). The low correlation makes sense because the need to belong is an individual difference related to a basic motivation and high or low levels of this trait should not determine how much the person perceives this motivation to be achieved in a particular moment – this would be determined by many other cognitive and cultural factors (Cacioppo et al., 2006; Hawkley & Cacioppo, 2010; Seppala, Rossomando, & Doty, 2008). A lower need to belong is not necessarily more easily satiable and a higher need to belong is not necessarily harder to satiate. But if social connectedness and loneliness are opposites, it could be expected that both would at least exhibit a similar pattern of correlation with respect to the magnitude of association with the need to belong and in opposite directions, which could be interpreted as a source of evidence for the validity of the scores generated from the instruments.

Method

Participants.

The sample was composed of 323 university students. The mean age was of 24.63 years (*SD* = 8.63) and was mainly composed of woman (female: 233; male: 88; did not report: 2). Most participants were single (N = 147), dating (N = 120), or married (N = 46) (divorced: 7; widower: 1; did not report: 2). The number of participants was estimated using the pwr package (Champely, 2012) of the language and computational environment R (R Core Team, 2017). To obtain a power of .80 with an alpha value of .05 and at least an expected low effect size (.20) for a correlation test, a sample of 194 participants was demanded. We mentioned earlier that there are reasons to expect a strong correlation between the variables under investigation, but we opted to take a conservative approach and use an expected low effect size in the power analysis as there is no previous evidence about their relationships in Brazil.

Instruments and materials.

Social connectedness.

The Portuguese version of the social connectedness scale (see Study 2 in the present dissertation and Appendix 1) was used and it is composed of seven items developed by Lambert et al. (2013) (for more details about this instrument, see the description in Study 1). The Kaiser-Meyer-Olkin test of sampling adequacy was .84, which can be considered acceptable and the Bartlett's test of sphericity was significant ($\chi 2$ (21) = 627.64, $p < .001$). The communalities between the items were all above .49. Considering this, we assumed that the scale was appropriate for the analysis. A parallel analysis indicated that three factors should be extracted. The variance accounted by the second and third factors was close to zero so we interpreted the results of the parallel analysis as indicating a likely one-factor structure as the most appropriate to assume. We were even more confident of this decision considering that the scale has been shown by previous studies to conform well to a one-factor structure and that the conceptual definition underlying the instrument assumes a unidimensional

construct. An exploratory factor analysis assuming one factor and adopting principal axis factoring as the extraction method indicated a reasonable fit of the data. Factor loadings varied from .52 to .72 and the factor accounted for 47% of the variance. We then computed a Bartlett score (Uluman & Doğan, 2016) as the main social connectedness index. Higher scores represent higher levels of social connectedness. The evidence of reliability in the present research was acceptable ($\alpha = .81$).

Loneliness.

The Portuguese version (Campelo & Pilati, 2017) of the revised UCLA loneliness scale (Russell, 1996) was used (see Appendix 4). The evidence of reliability in the present research was acceptable ($\alpha = .88$). The Kaiser-Meyer-Olkin test of sampling adequacy was .91, which is an acceptable level and the Bartlett's test of sphericity was significant ($\chi2$ (190) = 2386.48, $p < .001$). The communalities between the items were all above .47.

A parallel analysis indicated that four factors should be extracted. This is coherent with the previous discussion developed in the introduction of the present study regarding the content of UCLA's items; although the third and fourth factors are associated with eigenvalues lower than 1. We decided to compare the conclusions we would get by extracting both the one factor solution usually assumed in the literature and the four factors indicated by our own analysis. The exploratory factor analysis adopting principal axis factoring as the extraction method showed that the items conformed acceptably to a one-factor structure. Factor loadings varied from .36 to .73 and the factor accounted for 35% of the variance. We then computed a Bartlett score as the main loneliness index. Another exploratory factor analysis adopting principal axis factoring as the extraction method and oblimin as the rotation method indicated that the items did not conform acceptably to a four-factor structure. The analysis indicated that six items presented loadings higher than .30 in more than one factor and there was no clear conceptual pattern underlying the items grouped in a specific factor.

This reinforces our concerns about the lack of clarity resulting from a lack of conceptual rationale underlying the instrument development and about the intimate relationships between the different constructs represented in the contents of the items.

Need to belong.

The Portuguese version (Gastal & Pilati, 2016) of the need to belong scale (Leary et al., 2013) was used (see Appendix 5). It is an individual difference measure of the desire to have positive and meaningful relationships. It is a unidimensional scale composed of 10 items associated with a Likert scale of five response options varying from "totally agree" to "totally disagree". A parallel analysis indicated that four factors should be extracted from the need to belong scale. As there is no previous rationale on how to extract more than one dimension from this scale, we initially assumed a one factor structure as the original authors. The factor analysis with principal axis factoring as the extraction method indicated an unsatisfactory fit of the data. Items 1, 3, and 7 loaded below .30 on the factor and factor loadings from the rest of the item varied from .44 to .79. Another factor analysis assuming a two-factor structure showed that items 1, 3, and 7 loaded on a second factor with factor loadings varying from .39 to .56 while the rest of the items similarly loaded on one factor as they did before. These three items are exactly the three items with reversed meaning that must have their values reversed before computing the score. We computed one factor for this scale excluding the three negative items and the factor score presented acceptable reliability ($\alpha = .81$). Finally, we then computed a Bartlett score as the main need to belong index. Participant's age, sex, and marital status was measure with a socio-demographic questionnaire. All of the statistical analyses were performed using the R language and computational environment (R Core Team, 2017).

Procedure.

Participants were invited in a university campus to take part in a study about social relationships. They first received an informed consent that explicitly emphasized that the

participation was anonymous, voluntary, and that the participant could end his participation at any time without any potential harm associated with it. If participants agreed with the informed consent, then they answered the scale in the following order: UCLA Loneliness Scale, Social Connectedness Scale, socio-demographic questions, and the Need to Belong Scale.

Data analysis.

Statistical analyses were also performed using the R language and computational environment (R Core Team, 2017). We used different procedures to diagnose and deal with missing data. The Little's missing completely at random (MCAR) test indicates whether columns or rows in the dataset have more than 5% of missing data. Only 0.368% of the total cells are missing values. Three participants presented more than 30% of missing data and we decided to exclude them from the sample. The test for missing completely at random (MCAR) and Homoscedasticity from the MissMech package indicated that there was not sufficient evidence to reject MCAR ($p = 0.13$). Together, this information indicates that missing data probably follows a random pattern in our dataset and that we generally observed low levels of missing data. Considering this, we used the random forest method for multiple missing data imputation by means of the missForest package (Stekhoven & Buhlmann, 2012). Finally, we compared the descriptive statistics between the original dataset and the dataset after data imputation. The descriptive statistics were almost identical between datasets, except for very small differences in the hundredth of a few number of variables.

We found evidence that in the present research the distribution of the scores for social connectedness, loneliness, and the need to belong did not deviate strongly from a normal distribution. Graphical inspections and the values for skewness and kurtosis indicated that the deviations were low (all values of skewness were below -.41 and all values of kurtosis were below -.46 for the three scores). But as we know that at least social connectedness and

loneliness usually have more skewed distributions in the population (Cacioppo et al., 2015) we opted for a conservative approach and used mainly non-parametric techniques to analyze their relationships. We used Spearman's rho to estimate the associations between the scores and the 95% confidence intervals (CI) were calculated by bootstrapping with 1,000 replicates using the RVAideMemoire package.

Results

We found a strong negative association between social connectedness and loneliness ($r = -.80$, $p < .001$ (95% CI [-.84; -.76]). Both social connectedness ($r = .12$, $p = .04$ (95% CI [.006; .23]) and loneliness ($r = -.05$, $p = .41$ (95% CI [-.16; .06]) exhibited low association with the need to belong, although the correlation between social connectedness and need to belong was positive, statistically significant, and the confidence interval did not include zero while the correlation between loneliness and need to belong was negative, not statistically significant, and the confidence interval included zero. The spearman coefficient between social connectedness and the need to belong was more than twice as big as the correlation coefficient between loneliness and the need to belong.

To further investigate the dimensionality of the scales and the bipolarity hypothesis, we performed two exploratory factor analyses with principal axis factoring as the extraction method including all the items from the SCS and the UCLA. Before that, a parallel analysis indicated that 13 factors should be extracted, although most of the factors after the fourth one presented eigenvalues close to zero. An exploratory factor analysis assuming four factors did not yield coherent results – items from the UCLA loaded without a coherent meaning on the four factors. After that, we did a similar factor analysis but assuming a two-factor solution. The pattern of loading was also confusing and not coherent with the bipolarity hypothesis. Most of the items from both scales loaded on the first factor, and some items from the SCS (5, 6) and the UCLA (1, 5, 6, 9, 10, 15, 16, 17) loaded above .30 in the second factor. Most of

these items from the UCLA have contents related to social connectedness or social support. Items 5 and 6 from the SCS and items 15 and 16 from the UCLA loaded on the two factors with values above .30.
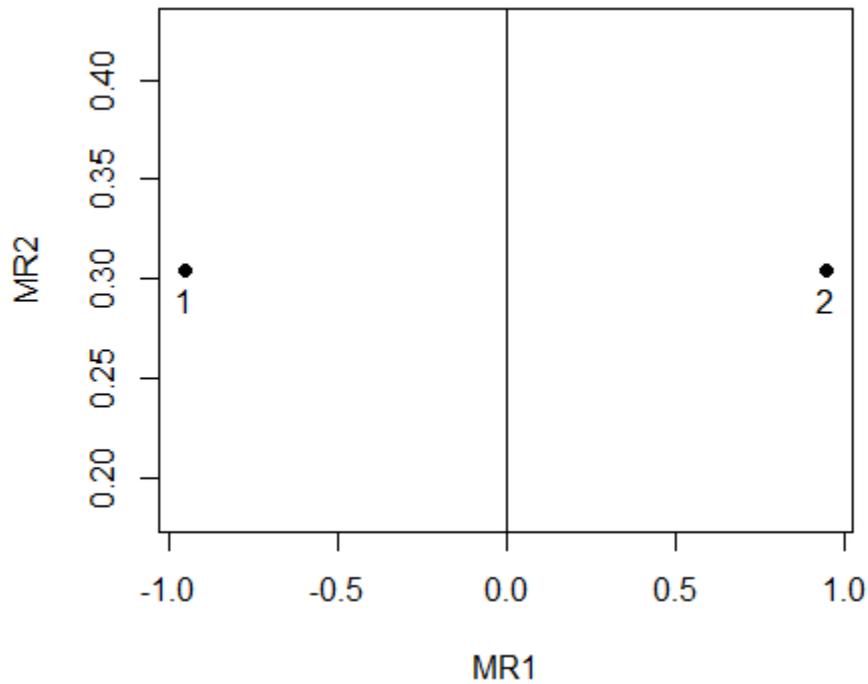

Figure 1. Angular separation of the social connectedness (1) and loneliness (2) scores.
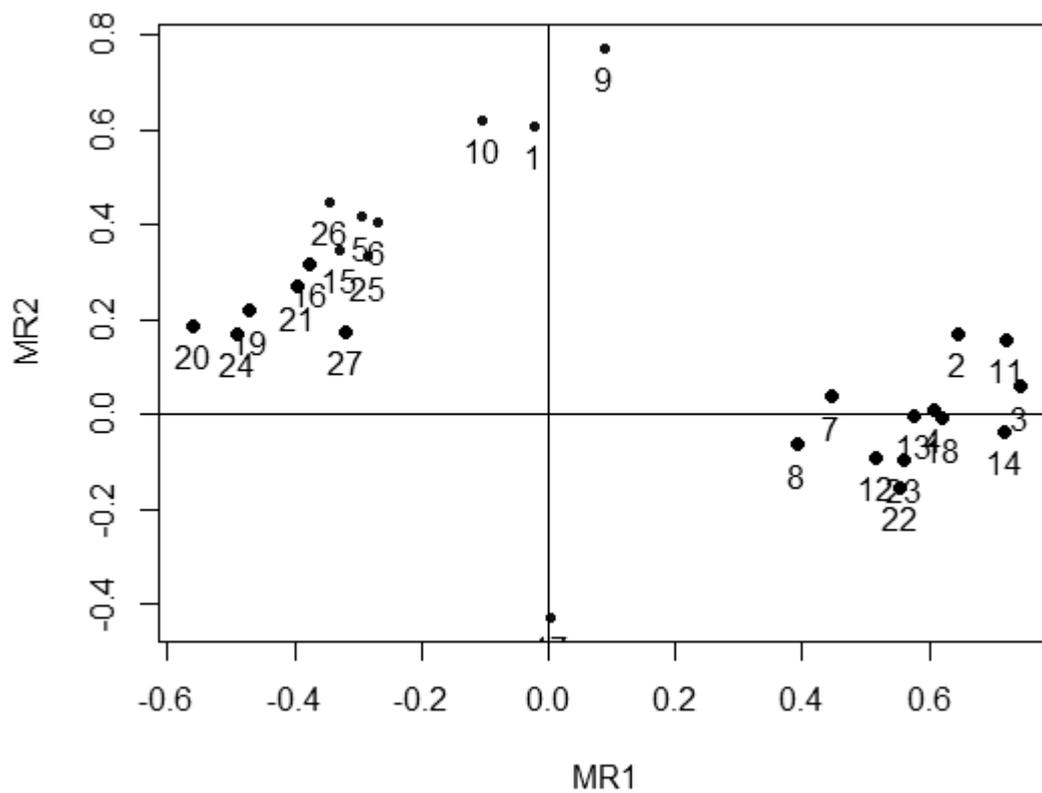
Figure 2. Angular separation of the social connectedness and loneliness items polar coordinates (points 1 to 20 represent UCLA's items and points 21 to 27 represent SCS's items).

Figure 1 shows a graph representing the angular separation of the polar coordinates derived from the two-dimensional factor loadings associated with the scores (Figure 1) or items (Figure 2). The procedure to convert the two-dimensional factor loadings to polar coordinates and plot it followed recommendations of previous authors (Rafaeli & Revelle, 2006). The graph presented in Figure 1 indicates an angular separation of 180 degrees, coherent with the bipolarity hypothesis. To further investigate the bipolarity hypothesis, we also plotted the polar coordinates associated with the two-dimensional factor loadings of the items from the UCLA and the SCS as can be seen in Figure 2. Two main clusters of items can be observed forming an approximately 180 degrees of angular separation, but a small cluster can also be seen in the superior part of the graph. Items 1, 9, 10, and 17 are not clustered with most of the other items. As we pointed out before, items 1 and 10 from the UCLA are related to social connectedness and item 9 is related to extroversion. The items from the SCS were not in the same cluster. Items 22 and 23, the two items of the SCS that have an inverse meaning, are part of a cluster together with most of UCLA's items that are more directly related to loneliness itself, except for UCLA´s item 3, which is more related to social support but have an inverse meaning too. The other cluster is composed of the five remaining items from the SCS (21, 24, 25, 26, and 27) and items 5, 6, 15, 16, 19, and 20 from the UCLA. As described earlier, items 5 and 6 from the UCLA are related to social connectedness and items 15, 16, 19, and 20 are related to social support. Finally, item 17 (which is the dot in the lower part of the graph) did not cluster with any other item and presented an angular separation close to 180º with item 9. This angular separation makes sense, as item 17 is related to shyness and item 9 is related to extroversion.

Discussion

We attained the goal of Study 3, which was to estimate the relationships between social connectedness, loneliness, and the need to belong and more specifically to produce evidence regarding the bipolarity hypothesis between social connectedness and loneliness. The estimation of such relationships summed up to previous findings indicating the acceptable levels of reliability and validity of the SCS in Brazil (see Study 2 in the present dissertation). The results from the parallel analysis and the exploratory factor analysis indicated that the factor structure of the UCLA and the need to belong scale are potentially questionable, which might be a repercussion of the problematic theoretical issues surrounding the measures and studies of these topics as previously explored in the present research and elsewhere (see Study 1 in the present dissertation). We found evidence that social connectedness is strongly and negatively related to loneliness, while both are weakly related to the need to belong. This finding is coherent with the widespread assumption that loneliness and social connectedness are approximately opposite constructs (Bekhet et al., 2008; Cacioppo & Hawkley, 2009; Cacioppo & Patrick, 2011; Epley et al., 2008; Hawkley & Cacioppo, 2010) and with previous estimates about their relationships with the need to belong (Leary et al., 2013). Nevertheless, social connectedness presented a considerably different kind of relationship with the need to belong compared to loneliness, which is not coherent with the idea of perfect opposition between outcomes of fulfilling this basic need (Bekhet et al., 2008; Cacioppo & Hawkley, 2009a; Cacioppo & Patrick, 2011; Epley et al., 2008; Hawkley & Cacioppo, 2010). Considering one of the main six issues in this literature pointed out in Study 1 of the present dissertation (see section "The need to belong: to feel connected, to avoid loneliness or something else?"), this result might indicate that higher levels of social connectedness are comparatively more important to determine the satisfaction of the need to

belong than lower levels of loneliness, but this conclusion would demand further exploration to be properly evaluated.

Although the angular separation between the social and loneliness aggregated scores corroborated the bipolarity hypothesis, an analysis of the angular separation between the items from the scales corroborated our concerns regarding the problematic conceptual foundation underlying the UCLA. First, a high angular separation could be observed between three different clusters of items from the UCLA. Items from SCS clustered with different groups of items from the UCLA in a coherent direction with our interpretation regarding the lack of conceptual clarity of the UCLA: the items from SCS that represent the presence of social connectedness clustered with items from the UCLA that also represent the presence of social connectedness and social support while the two items from the SCS that represent the absence of social connectedness clustered with items from the UCLA that represent loneliness and absence of social support. Considering this, it is not surprising to find a strong and negative correlation between the Bartlett scores derived from the instruments as a small percentage of the SCS items have likely a similar behavior, although inversed, of many items of the UCLA and a considerable percentage of the UCLA items have a likely similar behavior, although inversed, of most items from the SCS when their angular separations are plotted.

This pattern of angular separation is also coherent with the interpretation that the evidence accumulated regarding UCLA's validity might be partially explained by the inflation of correlations with other measures as we have hypothesized. This could happen because it comprises by means of its items different albeit closely related constructs that are also strong predictors of similar variables that loneliness usually predicts well. The fact that it also has many items that captures aspects of social connectedness that must be reversed before the computation of the final score is possibly one of the main mechanisms of inflation

of the correlation of the UCLA with measures of social connectedness such as the SCS. If this is true, then conclusions regarding loneliness that are derived from such a measure might be super estimated by this measurement artifact. These conclusions are coherent with the conceptualization brought by the connectedness and loneliness model (CLM) (see Study 1 of the present dissertation). The CLM describes social connectedness and loneliness as interrelated but not opposite multidimensional constructs. A more systematic investigation of this matter demands measures that are more well delimited conceptually than the UCLA, so although the evidence from the angular separation of the items factor loadings is relevant to discuss this aspect of the CLM, it still demands further investigation. Despite the evidence against the validity of the UCLA, we believe that the comparison of the conclusions derived from it with other measurement procedures is important to estimate the extent to which these problems with the UCLA impact the conclusions that are derived from it. Additionally, Study 3 offered only one source of evidence about the validity of the UCLA. A more extensive exploration of the problems associated with its validity seem justified considering its importance in the field of social psychology. For this reason, we used the UCLA along most of the studies reported in the present dissertation.

One limitation of the present study is that although we found evidence incoherent with the bipolarity hypothesis, this evidence does not prove that the bipolarity hypothesis is wrong. One of the reasons for this is that it is not clear what exactly the UCLA is measuring. Other loneliness measures that are more conceptually interpretable could lead us to less ambiguous conclusions. We were unable to evaluate any evidence of differential validity related to external variables between the measures. This could enrich our discussion about the assumed bipolar relationship between social connectedness and loneliness by evaluating how the scores of these variables relate to other variables such as well-being and mental health (Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015; Seppala et al., 2008). If they relate

to these variables in a considerably different way regarding the magnitude of prediction of other psychological or behavioral phenomenon, this would add weight to the argument that they should not be assumed to have a bipolar nature with one another. If both variables are predictors of other variables in similar magnitudes but opposite directions, this would be coherent with the bipolarity hypothesis. In either case, this kind of information would help us to make a better distinction between these important psychological concepts and to further explore the bipolarity hypothesis. Another important step for future research is to compare the predictive power of different measures of loneliness and social connectedness. Especially in the case of loneliness, it would be interesting to compare the conclusions derived from the UCLA with other measures that have a more clear and explicit conceptualization underlying its development and interpretation. Future studies should also include measures of other constructs, such as social support, to evaluate the level of differentiation between the items of the UCLA and the items from these other measures.

Study 4: The Stability and Comparative Predictive Power of Social Connectedness, Loneliness, and Social Support Regarding Mental Health and Satisfaction with Life

Mental health and well-being are influenced by many psychological, biological, social, and cultural processes. Of special importance to the present study, social connectedness, loneliness, and social support can have important effects on both according to previous studies (Cacioppo & Hawkley, 2003; Cacioppo, Hawkley, Norman, & Berntson, 2011; Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015; Detrie & Lease, 2007; Eisenberger & Cole, 2012; Feeney & Collins, 2015; Seppala, Rossomando, & Doty, 2008). What is behind these effects is still far from understood (see Study 1 in the present dissertation for a detailed overview) and to better understand the relationships between these variables it may be useful to examine some of the theoretical assumptions underlying these studies.

The goals of the present study were threefold: 1) to compare the predictive importance of social connectedness, loneliness, and social support regarding mental health and satisfaction with life; 2) to develop a pictorial measure of social connectedness and evaluate its psychometric qualities; 3) and to evaluate the stability of the scores derived from these measures. This study can help to judge the practical usefulness of alternative measurement approaches such as pictorial approaches at measuring broad and abstract concepts such as social connectedness and loneliness. Additionally, this evidence might be useful for exploring the propositions of the connectedness and loneliness model (CLM) regarding the way these constructs are mentally represented and their stability (see Study 1 in the present dissertation).

The Mental Representation of Social Connectedness and Loneliness

One important aspect of the studies mentioned before is that most of them are based on the use of self-report measures. Although this is a common measurement procedure used in personality and social psychology, one might ask if they are the most appropriate option to

capture highly abstract and not necessarily verbally represented constructs such as social connectedness and loneliness (Aron, Aron, & Smollan, 1992). In either case, having alternative measurement procedures available with different theoretical assumptions about the phenomena of interest will probably enrich our possibilities of measuring and understanding psychological phenomena in innovative ways (A. G. Greenwald, 2012). In the present study, we were interested in developing an alternative measurement procedure for social connectedness based on ideas developed by some authors about the structure of interpersonal closeness (Aron et al., 1992).

In cognitive science it is understood that there are different ways in which information can be mentally represented (Thagard, 2005). One could argue that a person's sense of social connectedness and loneliness may not be mentally represented verbally and/or as declarative memory as self-report measures usually assume. Because we are dealing with a broad and abstract construct, people may represent it in a broader and more abstract way than in a detailed, verbal, conscious, and explicit way. According to some authors, people may represent their relationships with others in terms of spatial metaphors (Otten & Epstude, 2006; Schubert & Otten, 2002). In different languages, spatial concepts are used to express the perception of a person in relation to other people and groups (i.e. "I am *a part* of this group"; "I want to *get out* of this group"; "I feel *close* to her"; "I feel like you are so *distant* from me these days").

The idea proposed by this embodied approach is that people understand and think about the abstract social relationships that they have in terms of more concrete spatial concepts related to physical closeness, distance, inclusion, and exclusion. The nature of our mental representations of the relationships between the self and others might be more directly based on abstract spatial metaphors than detailed verbal representations that people could be able to readily retrieve and inform with precision upon request (Nisbett & Wilson, 1977).

Comparing measures that assume different types of mental representations is a relevant effort to understand the most useful way to conceptualize the structure and nature of social connectedness and loneliness. With that in mind, we developed and evaluated the psychometric qualities of a pictorial measure of social connectedness that is better described in the method section.

Antecedents of Mental Health and Well-Being

Understanding the mechanisms underlying the antecedents of mental health and well-being can bring many important theoretical and practical implications (Bastian et al., 2015; Eisenberger & Cole, 2012; Jose et al., 2012; Mogilner, 2010; Sin & Lyubomirsky, 2009). The connectedness and loneliness model (CLM) allows the prediction that social connectedness and loneliness can have different impacts on outcome variables such as mental health and well-being (see Study 1 in the present dissertation). If this is the case, then maybe one of them might be more important than the other to fulfill our need to belong and this is a theoretical issue that has not been directly explored in the literature. Another possibility proposed by the CLM is that different sources of connectedness might impact differently outcome variables such as mental health and satisfaction with life. In that sense, the present study can allow the exploration of some of the basic tenets of the CLM.

The present study was an attempt to compare the relative importance of each predictor of mental health and satisfaction with life. We expected that, although both social connectedness and loneliness would prove to be strong predictors, the magnitude of their influence would differ considerably. More than that, if we identified a considerable difference between them, we were interested in evaluating if this difference was mainly due to a true difference between the constructs or if it is due measurement artifacts (see Study 1 and 3 in the present dissertation).

Social support is also a relevant construct when it comes to understanding the interpersonal antecedents of health-related variables (Feeney & Collins, 2015). Including social support in our study also allowed us to explore another assumption of the CLM (see Study 1 of the present dissertation). This model proposes that a core cognitive process underlying the experience of social connectedness is the perception of reciprocal affect shared with entities. Some conceptualizations of social support include the dimension of emotional support as one of the main types of support that people can derive from their social networks (Feeney & Collins, 2015; Siqueira, 2008). The fact that measures such as the Perception of Social Support Scale (EPPS) (Siqueira, 2008) provide items describing this specific emotional feature of social support would be valuable to evaluate the influence of the perception of emotional availability from others on different outcome variables compared to the broad idea of social connectedness. Although the definition of emotional support differs from what the CLM describes as the perception of reciprocal affect with entities, it may be one of the conceptually closest constructs already available in the literature and related to the idea proposed by the model. The comparison of predictive power between it and the other predictors might be a broad indication of at least the plausibility of the idea assumed in the CLM.

Another issue relevant for the present study is the stability of the constructs mentioned before and of the relationships between them. Some studies have found that the relationships between some of them are reasonably stable across time (Jose & Lim, 2014; Jose et al., 2012; Vanhalst et al., 2015). Unfortunately, this topic has not received much attention from the literature and we are not aware of any study that evaluated at the same time the relationships between all the variables that we are considering in the present study. Another limitation from previous studies is that they were circumscribed to specific cultural contexts such as North Americans samples. To begin the exploration about the temporal dynamics associated with

these relationships in Brazil, we collected our data two times across a period. By evaluating

the stability of the constructs, we would also be able to estimate the internal consistency of

our developed pictorial measure. As it is a one-item instrument (the description of the

instrument is available in the method section), an estimation by means of the test-retest

reliability method appeared to be one of the most appropriate.

Method

Participants.

Data was collected with 340 university students in two occasions. Only 109

participants completed the study twice. Three participants were excluded from the final

sample because showed evidence of lack of basic understanding of the task (i.e. leaving half

of the questionnaire in blank, answering some of the scales while leaving others in blank).

The final sample consisted of 106 participants that answered to the same measures twice with

2 months of distance between measurement 1 and 2, henceforth called respectively as M1 and

M2. The sample was mainly composed of 85 women (21 men) that were single (N = 40), in a

serious relationship (34), married (N = 26) or divorced (N = 6). The mean age of the sample

was 28.05 (*SD* = 10). A sample estimation for a one-sample proportion test considering a

power of .80, an alpha value of .05, and at least a medium to high expected effect size (.40)

indicated that 65 participants would be necessary. We used the pwr package (Champely,

2012) of the R programming environment and language (R Core Team, 2017) to do this

power analysis.

Instruments and materials.

Self-report measure of social connectedness.

The adapted version to Portuguese (see Study 2 in the present project and Appendix 1)

of the Social Connectedness Scale (SCS) developed by Lambert et al. (2013) was used. It is a

seven-item scale that measures the subjective experience of belonging and there are five

options of response to them varying from "totally disagree" to "totally agree". Two separate parallel analyses were conducted with items from M1 and M2 and both indicated the extraction of two factors, but the second factor presented an eigenvalue close to zero in both cases. Considering this and the fact that there is previous evidence of an acceptable fit of a one-factor solution (see Study 2 and 3 of the present dissertation) as the original instrument assumes, we applied an exploratory factor analysis assuming a one-factor solution with principal axis factoring as the extraction method. Factor loadings varied from .40 to .74 (M1), .41 to .75 (M2) and the model presented acceptable fit levels (R^2 $_{M1, M2}$ = .82; Tucker Lewis Index of factoring reliability = .76, .71; RMSEA = .144, .165, 90% IC [.094; .189, .115; .208]; fit based upon off diagonal values $_{M1, M2}$ = 0.92). We then computed two Bartlett scores (Uluman & Doğan, 2016), one for each measurement occasion, as the main social connectedness indexes. Higher scores represent higher levels of social connectedness. The scores derived from this instrument exhibited acceptable levels of reliability (α = .85, .87; ω = .78, .79; test-retest = .69, $p < .001$ (95% CI [.58; .78])).

Pictorial measure of social connectedness.

In the present study, we developed the Pictorial Measure of Social Connectedness (PC) that was based on the general structure of the Inclusion of the Self in Other Scale (Aron et al., 1992) (see Appendix 7). Although it is like the OSIO (see Study 2 in the present dissertation) it has crucial and significant differences in comparison to that measure. This is a pictorial measure in which participants visualize two circles with different physical distances between them in different response options and they must choose the option that best represent themselves considering the criteria established in the instructions. Participants were presented to seven options of images representing the closeness between themselves and people in general. Each image exhibited two circles with different degrees of physical proximity and the options varied regarding how close the circles were spatially disposed. The

label "você" ("you") was presented beneath the smaller circle in the left while the label "pessoas" ("people") was presented beneath the bigger circle in the right. The images varied from a disposition where two circles were distant from one another to a disposition in which the smaller circle was completely inside the bigger circle. Participants received the following written instruction in the beggining of the task: "Por favor, marque um "X" no quadrado ao lado da imagem que melhor descreve a proximidade entre você e as pessoas de modo geral [Please mark an "X" in the square next to the image that best describes the proximity between you and people in general]." The instrument was initially applied to 10 participants to verify how comprehensible the instrument was and to evaluate the easiness of responding to the instructions. No participant reported any kind of difficulty. The PC exhibited acceptable levels of reliability (test-retest = .66, $p < .001$ (95% CI [.53; .75])).

Loneliness.

The Portuguese version (Campelo & Pilati, 2017) of the revised UCLA Loneliness Scale (UCLA) (Russell, 1996) was used in the present study (see Appendix 4). Participants must indicate their response using a frequency scale of four response options varying from "never" to "always". The parallel analyses related to M1 and M2 indicated the extraction of four factors. Two exploratory factor analyses adopting principal axis factoring as the extraction method and requesting four factors indicated an incoherent and inconsistent pattern of item loadings on the four factors. Due to the lack of clear interpretability, we decided to follow the previous factor solution in the original studies of the UCLA and performed the same factor analysis as before but requesting one factor only. Factor loadings varied from .43 to .75 (M1), .52 to .77 (M2) (item 17 presented a loading of .25 and was not included in the computation of the score) and the model presented acceptable fit levels (R^2 = .93, .94; Tucker Lewis Index of factoring reliability = .81, .84; RMSEA = .098, .094, 90% IC [.074; .105, .071; .102]; fit based upon off diagonal values = .96, .97). Bartlett scores were computed

(Uluman & Doğan, 2016), one for each measurement occasion, as the main loneliness indexes. Higher scores represent higher levels of loneliness. Scores exhibited acceptable levels of reliability (α = .93, .94; ω = .95, .95; test-retest = .76, p < .001 (95% CI [.66; .83])).

Social support.

We used the 29-item Perception of Social Support Scale (EPSS) (Siqueira, 2008) (see Appendix 8). This instrument assumes a multidimensional conception of social support according to which social support is related to the psychological and material resources that are available to someone through this person's social network. Social support would be composed of three dimensions: emotional, instrumental, and informational support. Emotional support is the perception that one's social network is available to offer affective resources such as attention and comprehension; instrumental support is the perception that one's social network is available to offer concrete and objective resources such as money or material goods; and informational support is the perception that one's social network is available to offer suggestions, orientation, and explanations. The instrument requests that participants report the frequency with which they perceive the availability of their social network to offer these different types of support by means of a frequency scale of four options (1 = nunca [never]; 2 = poucas vezes [rarely]; 3 = muitas vezes [frequently]; 4 = sempre [always]). Despite assuming a three-dimensional construct for its development, the authors of the instrument found evidence that a two-factor structure was the best solution by means of a factor analysis. These factors were emotional support and what the authors called practical support. This last dimension encompassed the items for instrumental and informational support.

We performed two parallel analysis that indicated the extraction of two factors. We then performed a factor analysis adopting principal axis factoring as the extraction method, oblimin rotation, and requested two factors – practical and emotional support. We found the

same pattern of factor loadings as the original authors, with items related to practical support loading on one factor while items related to emotional support (items 20 to 29) loading on a second factor. Factor loadings varied from .40 to .91 (M1), .30 to .92 (M2) and the model presented acceptable fit levels (R^2 = .94, 96; .97, .94; Tucker Lewis Index of factoring reliability = .80, .83; fit based upon off diagonal values = .98, .99). Four Bartlett scores (Uluman & Doğan, 2016) were computed from the responses representing the following dimensions: emotional (M1 and M2) and practical support (M1 and M2). Scores exhibited acceptable levels of reliability (practical: $\alpha_{M1, M2}$ = .94; $\omega_{M1, M2}$ = .95; test-retest = .70, $p <$ .001 (95% CI [.59; .79]); emotional: α = .95, .96; $\omega_{M1, M2}$ = .97; test-retest = .60, $p < .001$ (95% CI [.46; .71])).

Mental health.

We used the adapted version of the Five-item Mental Health Index (Damásio, Borsa, & Koller, 2014a) (see Appendix 6). It is a global measure of mental health focused on depressive and anxiety symptoms common to most mental disorders and it is composed of five items. Participants can choose their response from a frequency scale of five options varying from "never" to "all of the time". The instruction of the measure defines the time frame of reference as how the participant has been feeling for the last four weeks. Two parallel analysis indicated the extraction of three factors, but as the scale has five items we concluded that it would be an interesting synthesis strategy to follow this indication. We then performed two exploratory factor analyses with principal axis factoring as the extraction method and requested one factor. Factor loadings varied from .35 to .86 (M1), .64 to .82 (M2) and the model presented acceptable fit levels (R^2 = .87, .85; Tucker Lewis Index of factoring reliability $_{M1, M2}$ = .64, .81; fit based upon off diagonal values $_{M1, M2}$ = .92, .98). Two Bartlett scores (Uluman & Doğan, 2016) were computed from the responses and scores exhibited

acceptable levels of reliability (α = .78, .84; ω = .88, .90; test-retest = .63, p < .001 (95% CI [.50; .73])).

Satisfaction with life.

The Portuguese version of the Satisfaction with Life scale was used (Gouveia, Milfont, da Fonseca, & Coelho, 2009) (see Appendix 6). It is a five-item measure of the domain-free global assessment about one's satisfaction with life. Responses are given by means of a seven-point scale with options varying from "discordo totalmente" ("totally disagree") to "concordo totalmente" ("totally agree"). Two parallel analysis indicated the extraction of one factor. Considering this we performed two exploratory factor analyses with principal axis factoring as the extraction method and requested one factor. Factor loadings varied from .67 to .83 (M1), .60 to .88 (M2) and the model presented acceptable fit levels (R^2 $_{M1, M2}$ = .87; Tucker Lewis Index of factoring reliability $_{M1, M2}$ = 1.00; fit based upon off diagonal values $_{M1, M2}$ = 1.00). Two Bartlett scores (Uluman & Doğan, 2016) were computed from the responses and scores exhibited acceptable levels of reliability (α = .85, .82; ω = .88, .86; test-retest = .69, p < .001 (95% CI [.58; .78])). Participants reported their age, sex, and marital status by responding to socio-demographic questions.

Procedure.

Students from a private institution received the invitation to take part on a study. An informed consent was initially presented with basic information about the study (i.e. the subject of the research; the anonymity and secrecy associated with their participation; the fact that they could stop their participation whenever they wanted). If they agreed, participants were presented to the measures in the following order: Satisfaction with Life Scale (SLS), Five-item Mental Health Index (MH), UCLA Loneliness Scale (UCLA), Social Connectedness Scale (SCS), socio-demographic questions, Pictorial Measure of Social Connectedness (PC), and the Perception of Social Support Scale (PSSS). Participants were

then thanked for their participation. The criterion variables were presented first to avoid framing effects resulting from answering to the loneliness and social connectedness measures first. Answering to items of such a nature could bias they self-reported satisfaction with life, for example.

Data analysis.

The analysis was performed by using the R language and environment for computation (R Core Team, 2017). First, we evaluated the pattern of missing data. No item had more than two missing cases, which indicates that missing data was probably not a strong bias in the present study. The Little's missing completely at random (MCAR) test indicates whether columns or rows in the dataset have more than 5% of missing data. It indicated that the dataset did not have any columns or rows with more than 5% of missing data. Only 0.3% of the total cells were missing values. A dummy variable classified a participant in one of two categories: participants who had any missing value and participants who had no missing value. We used the Chi square test to evaluate if variables such as sex or marital status could influence the pattern of missing data. The test indicated that none of the variables explained significantly the pattern of missing data.

Because of this, we adopted the random forest method for multiple missing data imputation by means of the missForest package (Stekhoven & Buhlmann, 2012). Random forest is a machine learning and non-parametric technique of multiple missing data imputation especially interesting for datasets that contain both numerical, categorical variables, nonlinear and complex relationships between variables. There is evidence that it outperforms other methods of missing data imputation (Shah, Bartlett, Carpenter, Nicholas, & Hemingway, 2014; Stekhoven & Buhlmann, 2012). We then compared the descriptive statistics between the two datasets (original and dataset with imputed data) and they were almost identical.

Results

The two scores from each of the main dependent variables were screened for univariate and multivariate normality. The variables did not deviate strongly from a normal distribution considering that values of skewness were below .66 and values of kurtosis were below .90. The Shapiro-Wilk test was not statistically significant for most dependent variables, except for one of the scores of mental health (M1) and the two scores for the PC. The Mardia's, Henze-Zirkler's, and Royston's multivariate normality tests indicated that the main scores deviated considerably from the multivariate normality (the package MVN was used to run these tests, Korkmaz, Goksuluk, & Zararsiz, 2014). Considering that the variables generally preserved univariate normality but did not preserve multivariate normality, we considered appropriate to use parametric and non- parametric techniques in the analysis according to the assumptions of each technique that were corroborated. The associations between the main dependent variables can be seen in Table 2 (M1) and Table 3 (M2).

Table 2

Associations between the main variables in M1

Variable	1	2	3	4	5	6
1. Pictorial connectedness (PC)						
2. Loneliness (UCLA)	-.54**					
3. Connectedness (SCS)	.56**	-.79**				
4. Practical support (PS)	.31**	-.50**	.53**			
5. Emotional support (ES)	.27**	-.51**	.47**	-.08		
6. Satisfaction with life (SWL)	.31**	-.55**	.50**	.26**	.45**	
7. Mental health	.34**	-.65**	.56**	.31**	.46**	.50**

Note. * indicates $p < .05$; ** indicates $p < .01$.

Table 3

Associations between the main variables in M2

Variable	1	2	3	4	5	6
1. Pictorial connectedness (PC)						
2. Connectedness (SCS)	.61**					
3. Loneliness (UCLA)	-.59**	-.80**				

4. Practical support (PS)	.25**	.45**	-.57**			
5. Emotional support (ES)	.37**	.38**	-.48**	-.06		
6. Satisfaction with life (SWL)	.27**	.40**	-.49**	.39**	.27**	
7. Mental health	.34**	.48**	-.62**	.47**	.23*	.56**

Note. * indicates $p < .05$; ** indicates $p < .01$.
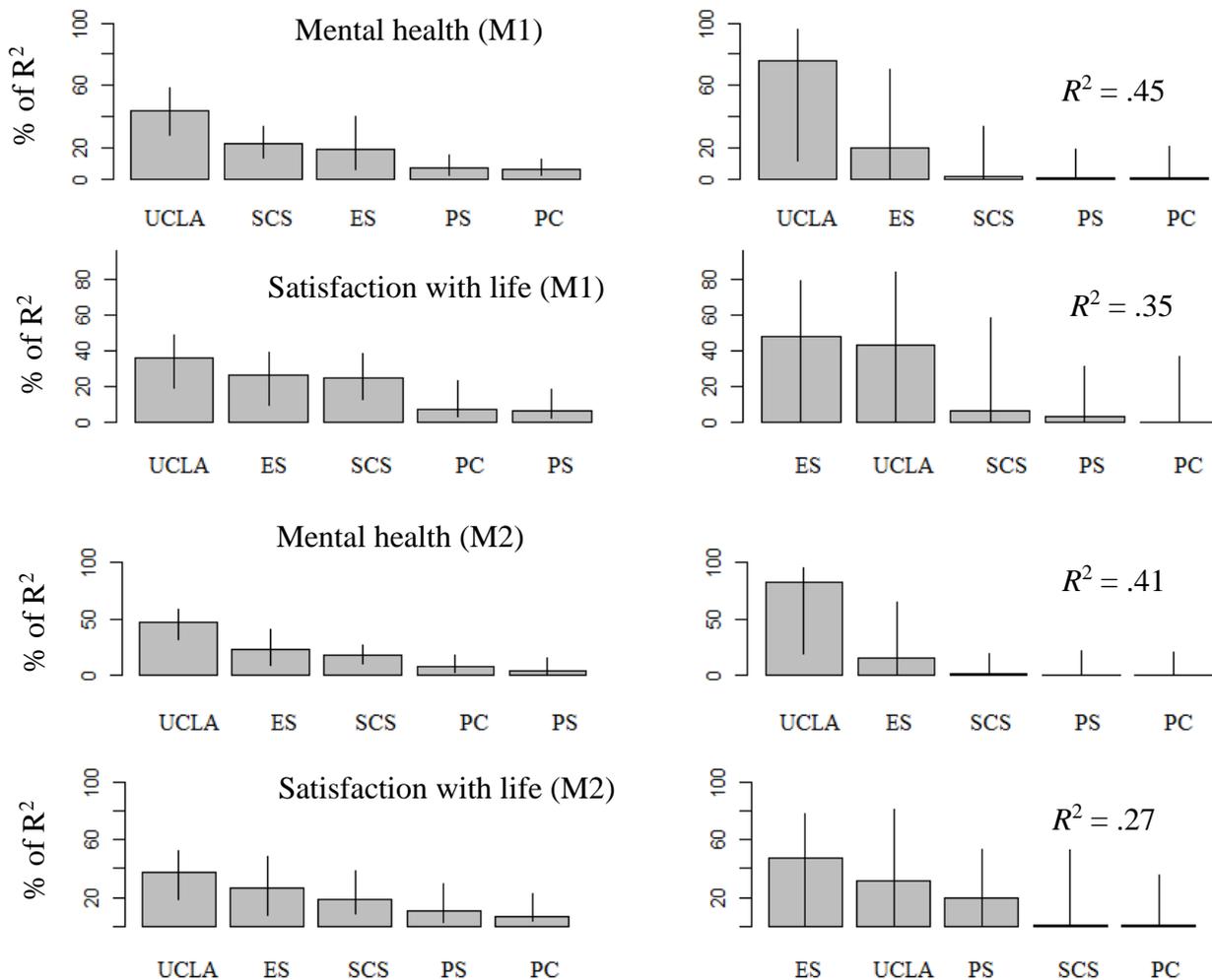

Figure 3: Relative importance of the predictors of mental health (first and third pairs of images) and satisfaction with life (second and fourth pairs of images) in M1 (top) and M2 (bottom) in terms of percentage of the R^2 (R^2 for each of the four regressions are presented in the right side of the Figure) with 95% bootstrap confidence intervals. Left graphs: LMG method; right graphs: last method.

We compared the relative importance of the dependent variables in predicting satisfaction with life and mental health by four multiple regressions after the statistical

assumptions were verified. The Durbin-Watson test for autocorrelated errors indicated that the assumption of independence of errors was also met in each of the four regression models (DW < 2.20, p > .28). No evidence of multicollinearity was observed as all predictors presented VIF < 5, except for the UCLA score in M2 (VIF = 5.09). The UCLA score in M1 was the predictor that presented the highest value too (VIF = 3.74). The assumption of linearity was supported by the visual inspection of the normal Q-Q plot, the residuals versus fitted plot and the scale-location plot.

We compared the importance of the predictors by using two different methods of hierarchical partitioning of the coefficient of determination (R^2) (Chevan & Sutherland, 1991). The graph (see Figure 3) represents the percentage of the R^2 that is explained by each predictor in the regression in order of magnitude. The LMG method (left side of Figure 3) partitions the R^2 by averaging over orders of inclusion of the predictor in the model and the last method (right side of Figure 3) partitions the R^2 by considering the contribution of each predictor when included last in the model.

Corroborating the stability of the measures, results in M1 and M2 were very similar in terms of magnitude of relationships. Figure 3 indicates that the UCLA was generally the most important predictor across variables and partitioning methods followed by ES. On the other hand, PC and PS were generally the worst predictors. The UCLA was a considerably stronger predictor of mental health compared to satisfaction with life. Beyond that, the last method indicated ES as the most important predictor of satisfaction with life while indicated that UCLA was the most important predictor of mental health. To continue the exploration of the bipolarity hypothesis initially tested in Study 3 of the present dissertation, the scores' cartesian factor loadings were converted into polar/angular coordinates and plotted in a graph by means of the psych package and adopting the following procedure: "For each pair of factors, item loadings are converted to an angle with the first factor, and a vector length

corresponding to the amount of variance in the item shared with the two factors" (p. 280,
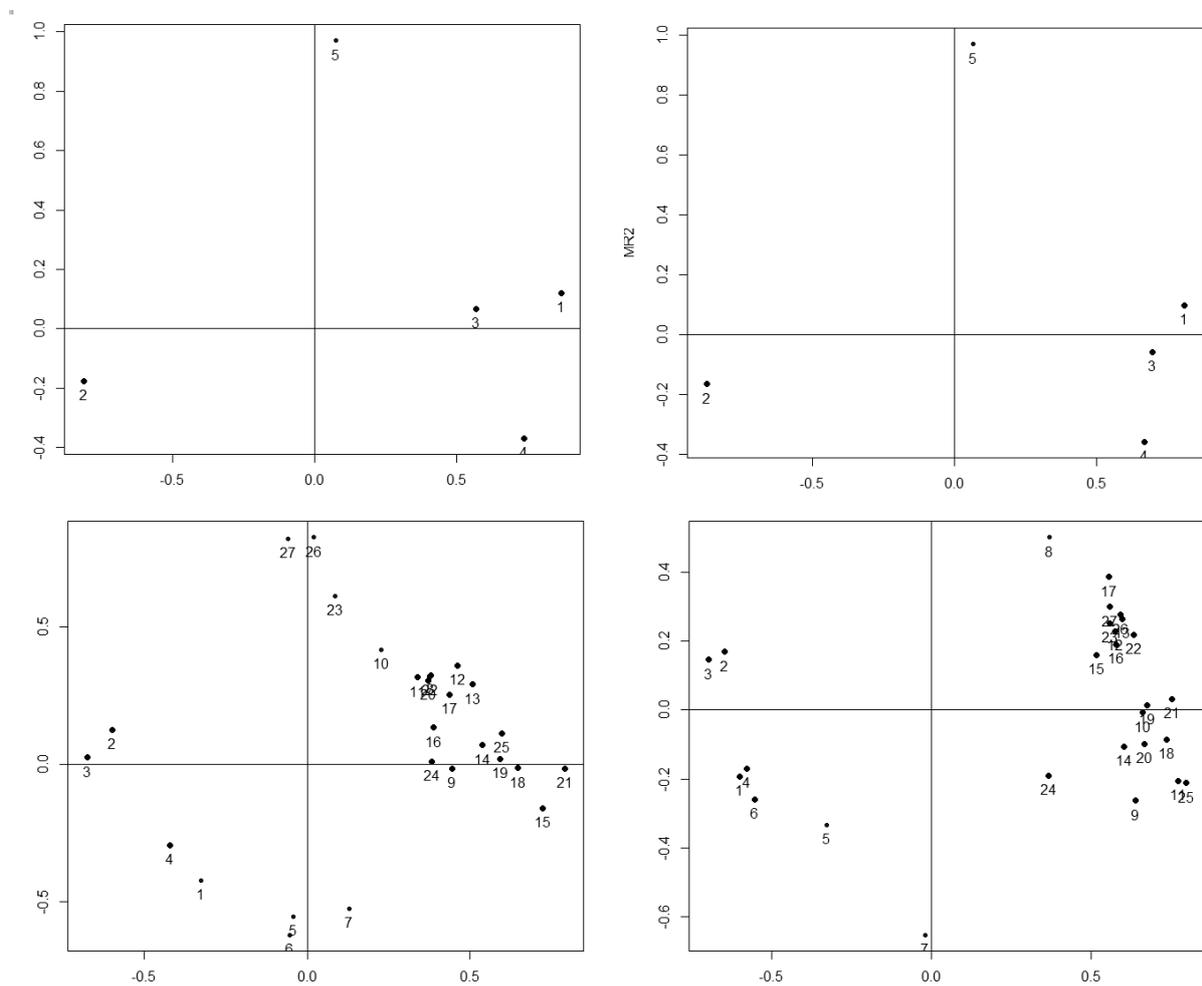
Revelle, 2017).

Figure 4: Angular separation of the main dependent variables (the SCS (1), UCLA (2), PC (3), PS (4), and ES (5)) (top) and of the items polar coordinates from the SCS and UCLA (bottom) in M1 (left) and M2 (right) (items 1 to 7 represent the items from the SCS and items 8 to 27 represent the items from the UCLA).

Considering the main scores from the predictor variables, the graphs for M1 and M2 presented a similar pattern of clustering. In both cases, SCS and PC belonged to a cluster while all the other scores did not cluster with any other score. The UCLA formed an angular separation of approximately 180 degrees with SCS and PC while the ES formed an approximately 90 degrees of angular separation with SCS and PC.

The bottom of Figure 4 shows two different patterns of clustering in M1 and M2. In M1, six main clusters can be observed with most of the items concentrating in two of the clusters at the right of the horizontal axis and the other four clusters include only two or three items mainly of the SCS. The cluster at the top of the graph concentrates two of the items from the UCLA related to social support. Items 3, 9, and 16 from the UCLA and item 7 from the SCS did not clearly cluster with other items or could not be differentiated regarding the cluster to which it was associated. At the right of the graph, one cluster concentrated the items 2, 7, 11, 12, 14, 17, 18, which is a mix of items related to social support, shyness, and loneliness, while the other cluster concentrated items 4, 5, 6, 10, 13, 15 from the UCLA, which are related mainly to social connectedness, loneliness, and social support. In M2, 4 clusters can be distinguished. Items 5 and 7 from the SCS and items 1 and 17 from the UCLA did not clearly cluster with other items. At the left side of the horizontal axis, one cluster concentrated items 2 and 3 from the SCS and another cluster concentrated items 1, 4, and 6 from the SCS. At the right side of the horizontal axis, one cluster included items 2, 3, 4, 7, 11, 12, 13, 14, and 18 from the UCLA, which are related to social support, loneliness, and social connectedness, while another cluster included items 5, 6, 8, 9, 10, 15, 16, 18, 19, and 20, which are related to social connectedness, social support, extraversion, and loneliness.

Discussion

We attained our initial goals and observed results relevant for many aspects explored by the connectedness and loneliness model (see Study 1 in the present dissertation). We developed a pictorial measure of social connectedness (PC) that demonstrated favorable evidence of factorial, convergent validity, and validity related to external variables. It also presented acceptable levels of reliability. Considering this, the PC is an alternative measurement procedure that should be further explored by scientists interested in the

phenomenon of social connectedness that may assist us from now on in the exploration of the mental representation of social connectedness.

The test-retest reliability estimates of the measures attested to the stability of the constructs captured by these measures and initially reinforce what other studies had found about the stability of some of the constructs here considered (Jose & Lim, 2014; Jose et al., 2012; Vanhalst et al., 2015). The results observed in the multiple regressions also showed that the relationships between the variables generally remained similar across time although some of them changed from M1 to M2.

We observed a coherent pattern with Study 3 of angular separation between the items of the SCS and UCLA. Like in that study, here we found that the items from the UCLA formed different clusters characterized by different configurations of clusters grouping items with different contents comparing M1 with M2. When comparing the most important predictors of mental health and satisfaction with life, the UCLA was especially important in predicting mental health compared to satisfaction with life. The percentage of the coefficient of determination associated with the UCLA was much smaller and in the case of the last method the UCLA was not considered to be the most important predictor of satisfaction with life.

We are not aware of any reason why loneliness would be more related to mental health in comparison to satisfaction with life. One possible explanation for this result comes from considering the origins of the UCLA. This instrument was not based on any conceptualization of what is loneliness (see Study 1 for more details). Instead, the authors produced the items mainly based on reports from depressive patients. It may be that this psychometric decision introduced a bias in the structure of the UCLA. As described in Study 3, the content validity of the UCLA is ambiguous and the contents of the items can be traced to different constructs other than loneliness itself such as shyness, extroversion, social

support, and social connectedness, all of which are variables associated with depression (Cruwys, Haslam, Dingle, Haslam, & Jetten, 2014b; Gotlib & Joormann, 2010; Klein, 2010)

These results reinforce the notion that the lack of conceptual clarity in the development of the UCLA may have unintentionally resulted in an instrument that have an ambiguous interpretation and even a questionable general validity. More importantly, the specific content configuration of the items might favor the inflation of associations with other variables as described in Study 3. This may be masked because the UCLA has indeed accumulated a great amount of evidence of reliability and validity in its favor (Cacioppo & Hawkley, 2009; Cramer & Barry, 1999; Russell, 1996; Russell, Peplau, & Cutrona, 1980). But this evidence does not prove that the UCLA is indeed measuring loneliness in any possible conceptualization of this phenomenon, it only corroborates the idea that, whatever it is that the UCLA is measuring, it seems to be acceptably reliable and valid according to these studies. We believe that, if our concerns about the validity of the UCLA are coherent, this makes this instrument a good example of how dangerous a lack of conceptual rationale in the development of an instrument can be to a field as it is the main source of information about loneliness for decades (Cramer & Barry, 1999; Messick, 1995).

After the UCLA, the second most important predictor of mental health and satisfaction with life across methods and measurement periods was emotional support (ES). The comparison between the contributions of the ES and SCS is relevant for the connectedness and loneliness model (see Study 1 in the present dissertation). The most important comparison is that ES and SCS presented similar contributions in some of the estimates but ES was a more important predictor in most of the cases. At least considering the last method, ES proved to be a much stronger predictor than the SCS. Although this is far from a direct evidence, this result corroborates the plausibility of the emphasis that the connectedness and loneliness model posits regarding the importance of the affective dimension in determining the impacts

that interpersonal integration may have on cognition and behavior. Future studies should more directly try to compare the importance of distinguishing this aspect from other more general aspects associated with social support and social connectedness.

Although the evidence was favorable regarding the psychometric qualities of the PC, we found that it was one of the worst predictors when compared to the others. This might have happened because, even if people use spatial metaphors to understand and represent their social relationships in memory, they may be aware at some level of these representations and this information can also be verbally represented from the spatial representations. When included last in the regression model, PC did not generally contribute considerably more than the other predictors. One possible interpretation for this is that PC may capture a construct that is the basis from which some of the other constructs are developed. But if this is the case, then the information that PC brings is already included somehow in the constructs measured by the other instruments. As this is the first evidence produced with this instrument, we believe that further investigation of its properties is warranted in future studies.

Our study had limitations. One of the greatest limitations was the mortality levels of participation in the study. Although this is an inherent feature of studies that try to evaluate patterns of variability across time, it diminished the power associated with our analyses and may have biased our conclusions. We believe that this is less of a severe threat to our conclusions when we compare the results from the present study with the other studies in the present dissertation because the patterns of results were similar and coherent with what was observed in them. Our study was not longitudinal, which would allow better estimates of the long-term stability of the temporal dynamics between the variables considered in the study. After this initial attempt to explore the temporal dynamics in short-term involved in the relationships between the constructs under investigation, an important step in the future would be to conduct a longitudinal study.

Study 5: A Predictive Comparison Between Different Types of Social Connectedness and Loneliness Measures

Advances in measurement methods are an important antecedent of scientific innovation (Greenwald, 2012). In psychology, measurement lies at the heart of many obstacles, especially because of the subjective and abstract constructs psychologists are usually motivated to understand. For example, advancement in the study of loneliness and social connectedness was greatly influenced by the development of new measures and since then the study of these constructs has witnessed a steady development throughout the last decades (Cacioppo & Hawkley, 2009b; Cacioppo & Patrick, 2008; Seppala et al., 2008). At least in the case of loneliness, there are different measures available with considerable evidence indicating favorable psychometric qualities (Cramer & Barry, 1999; Maes, Van den Noortgate, & Goossens, 2015). Despite it, there are many problematic issues still unsolved regarding these measures and their underlying conceptualizations.

One of the main problematic issues resides in the fact that the appropriate dimensionality underlying these constructs is a debate still underexplored both at the theoretical and measurement levels (Cramer & Barry, 1999). It is still not clear whether unidimensional or multidimensional conceptualizations and measures contribute in considerably different ways to predict other constructs, although there is evidence indicating that this is the case (DiTommaso & Spinner, 1997; Hosseinbor, Yassini Ardekani, Bakhshani, & Bakhshani, 2014; Salimi, 2011; van Baarsen et al., 2001; Weiss, 1973). The goal of the present study was to compare the predictive capacity of different types of measures (i.e. unidimensional self-report measure, multidimensional self-report measure, pictorial measure) of social connectedness and loneliness regarding variables previously known to be important consequences of loneliness and social connectedness (i.e. satisfaction with life, mental health) (Seppala et al., 2008). This study can help to judge the practical usefulness of alternative

measurement approaches such as multidimensional or pictorial approaches at measuring concepts such as social connectedness and loneliness. Additionally, this evidence might be useful for exploring the assumptions about the mental representation and dimensionality of these constructs as proposed by the connectedness and loneliness model (CLM) (see Study 1 in the present dissertation). One of the main assumptions of the CLM is that both connectedness and loneliness should be conceptualized and measured as multidimensional constructs as there are different and independent sources of connectedness from which people satisfy their need to belong. To explore the usefulness of a multidimensional approach to loneliness, one first step of crucial importance is to have a multidimensional measure of it. By comparing the predictive level of different types of measurement procedures that assume different theoretical conceptualizations about loneliness, we will be able to compare the kind of conclusions that each type corroborates and evaluate the usefulness of multidimensional approaches in comparison to unidimensional. Finally, the study will produce evidence of the validity underlying the scores derived from one multidimensional measure that we will adapt in the present study.

Multidimensional Approaches to Loneliness

Although the UCLA is the most commonly used instrument in the literature (Cramer & Barry, 1999) (see Study 1 in the present dissertation), some multidimensional approaches to the measurement of loneliness have been developed. For example, the Social and Emotional Loneliness Scale (SELSA) (Cramer, Ofosu, & Barry, 2000), the Loneliness Rating Scale (LRS) (Scalise, Ginter, & Gerstein, 1984) and more recently the Loneliness and Aloneness Scale for Children and Adolescents (LACA) (Maes et al., 2015) represent instruments developed from the criticism that loneliness should be understood as a multidimensional construct composed of dimensions that can be interrelated but are qualitatively different (Cramer & Barry, 1999). Despite these developments, the UCLA

remained throughout the last decades as the main source of information about loneliness in the scientific literature (see Study 1 in the present dissertation).

None of these multidimensional measures are available in Portuguese. To explore the dimensionality of loneliness and compare the UCLA with alternative measurement procedures it is necessary to adapt an instrument. We opted to adapt the abbreviated version of the SELSA (Cramer et al., 2000). The main reason for that is that, in comparison with other multidimensional measures, the SELSA is more commonly used and it assumes an explicit conceptual basis of the cognitive structure of loneliness. Another reason is that the LRS is more than 30 years old and the LACA is a scale only for children and adolescents while our interest is on adults and besides the scale was not publicly available at the time we conducted the present study. Considering these different factors, we thought that the SELSA was the most promising candidate for an adaptation. The process of adaptation will be described in the instruments and materials section.

Although we decided to adapt the SELSA to Portuguese in the face of the available alternatives, we are critical of some aspects of the measure. The main problem with it is the fact that, except for one item, all the items were written "positively", that is, indicating the absence of loneliness – in this case, it implicitly means the presence of social connectedness. We believe that this feature is another repercussion of the widespread assumption that the bipolarity hypothesis is true (see Study 3 in the present dissertation for more details). This might be a problem for the valid interpretation of the instrument, as one might argue that such a structure justifies the interpretation that this is a measure of social connectedness, not loneliness itself. Despite that argument, the evidence of psychometric qualities is favorable for the instrument and we believe that we can further explore the validity of this measure by comparing it with other loneliness and social connectedness measurement procedures, which is a secondary goal of the present study.

Method

Participants.

The study was conducted with 445 university students. The sample was mainly composed of women (N = 300). The mean age was equal to 24.14 (*SD* = 8.5) and most of the participants were single (N = 240) or dating (N = 132) (married: 61; divorced: 10; widower: 2). An initial sample estimation considering a power of .80, an alpha value of .05, and an expected low effect size (.20) for a correlation test indicated that 194 participants would be necessary. We used the pwr package (Champely, 2012) of the R programming environment and language (R Core Team, 2017) to do this power analysis. As the estimation of the relationships between these variables as measured by the instruments that we adopted in the present study is still scarce in Brazil, we adopted a conservative approach by assuming a low expected effect size and collecting data with a larger sample to increase its representativeness.

Instruments and materials.

Self-report measure of social connectedness.

An adapted version to Portuguese (see Study 2 in the present dissertation and Appendix 1) of the social connectedness scale (SCS) developed by Lambert et al. (2013) was used. The seven items are meant to capture the subjective experience of belonging (i.e. "I feel like there are many people with whom I belong" and "I really feel accepted by others in my life") and there are five options of response to them varying from "totally disagree" to "totally agree". It presented previously acceptable levels of reliability (α = .78-.81) and validity in Brazilian samples (see studies 2 and 3 in the present dissertation). The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .85, which can be considered acceptable. The Bartlett's test of sphericity was significant ($\chi2$ (21) = 926.62, $p < .001$). Considering this, we assumed that the scale was appropriate for the analysis. A parallel analysis indicated that three factors should be extracted. The variance accounted by the second and third factors was close

to zero. This led to the interpretation that the results of the parallel analysis indicated a one-factor structure. We were even more confident of this decision considering that the scale has been shown by previous studies to conform well to a one-factor structure (see all the previous studies in the present dissertation) and that the conceptual definition underlying the instrument assumes a unidimensional construct. An exploratory factor analysis assuming one factor and adopting principal axis factoring as the extraction method indicated a reasonable fit of the data. Factor loadings varied from .55 to .73. We then computed a Bartlett score (Uluman & Doğan, 2016) as the main social connectedness index. Higher scores represent higher levels of social connectedness. The evidence of reliability in the present research was acceptable ($\alpha = .82$; $\omega = .86$).

Pictorial measure of social connectedness.

We used the pictorial measure of social connectedness (see Study 4 in the present dissertation), which is based on the general structure of the Inclusion of the Self in Other Scale (Aron et al., 1992) (see Appendix 7). Participants were presented to seven options of images representing the closeness between them and people in general. Each image exhibited two circles with different degrees of physical proximity and the options varied regarding how close the circles were spatially disposed. The label "You" was presented beneath the smaller circle in the left while the label "People" was presented beneath the bigger circle in the right. The images varied from a disposition where two circles were distant from one another to a disposition in which the smaller circle was completely inside the bigger circle. Participants received the following written instruction in the beggining of the task: "Por favor, marque um "X" no quadrado ao lado da imagem que melhor descreve a proximidade entre você e as pessoas de modo geral. " Previous evidence indicated that the measure exhibited acceptable levels of test-retest reliability and considerable stability for 2 months (see Study 4 in the present dissertation) as well as favorable evidence regarding its validity.

Unidimensional measure of loneliness.

We used the Portuguese version (Campelo & Pilati, 2017) of the revised UCLA loneliness scale (Russell, 1996) (see Appendix 4). It is composed of 20 items asking the frequency with which the participant feels in a determined way. Participants indicate their response using a frequency scale of four response options varying from "never" to "always". The Kaiser-Meyer-Olkin test of sampling adequacy was .94, which is an acceptable level. The Bartlett's test of sphericity was significant ($\chi 2$ (190) = 4165.33, $p < .001$). A parallel analysis indicated that five factors should be extracted. The exploratory factor analysis demanding five factors and adopting principal axis factoring as the extraction method showed that the items did not present a logic pattern of loadings on the five factors. Another factor analysis assuming one factor as the literature usually assume showed that the items conformed acceptably to a one-factor structure. Factor loadings varied from .27 to .73. We then computed a Bartlett score as the main loneliness index. The reliability of the UCLA was acceptable in the present research ($\alpha = .92$; $\omega = .94$).

Multidimensional measure of loneliness.

We translated and adapted the abbreviated form of a multidimensional measure of loneliness known as the Social and Emotional Loneliness Scale (SELSA) (Cramer et al., 2000) (see Appendix 9). The measure assumes that the aversive experience of loneliness derives from perceived deficits in one or more out of three dimensions: romantic (R), familiar (F), or social (S). It is a fifteen-item scale associated with a concordance response scale of five points varying from "discordo totalmente" ("totally disagree") to "concordo totalmente" ("totally agree"). Three scores are computed from the responses representing loneliness in each of the following dimensions: social, romantic, and familiar loneliness. We used the back-translation and professional committee approaches for adapting this instrument (Cha et al., 2007). A committee of six researchers of the topic initially translated the original instrument

to Portuguese. A professional translator fluent in Portuguese and English independently back translated the Portuguese version to English and then the back translated version was compared with the original one to compare and seek for discrepancies. No major discrepancies were found and minor adjustments were implemented in the final version of the instrument. The evidence regarding its psychometric qualities is described in the results section.

Mental health.

We used the adapted version of the Five-item Mental Health Index (Damásio et al., 2014a) (see Appendix 6). It is a global measure of mental health focused on depressive and anxiety symptoms common to most mental disorders and it is composed of five items. Participants can choose their response from a frequency scale of five options varying from "never" to "all of the time". The instruction of the measure defines the time frame of reference as how the participant has been feeling for the last four weeks. The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .75, which can be considered acceptable. The Bartlett's test of sphericity was significant ($\chi2$ (10) $= 931.78$, $p < .001$). Considering this, we assumed that the scale was appropriate for the analysis. A parallel analysis indicated that three factors should be extracted. The variance accounted by the second and third factors was close to zero. Because of this, we assumed a one-factor structure. An exploratory factor analysis assuming one factor and adopting principal axis factoring as the extraction method indicated a reasonable fit of the data. Factor loadings varied from .57 to .76. We then computed a Bartlett score (Uluman & Doğan, 2016) as the main mental health index. Higher scores represent higher levels of mental health. The scale presented acceptable levels of reliability in the present study ($\alpha = .83$; $\omega = .90$).

Satisfaction with life.

The Portuguese version of the Satisfaction with Life scale was used (Gouveia et al.,

2009) (see Appendix 6). It is a five-item measure of the domain-free global assessment about

one's satisfaction with life. Responses are given by means of a seven-point scale with options

varying from "discordo totalmente" ("totally disagree") to "concordo totalmente" ("totally

agree"). The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .83, which can be

considered acceptable. The Bartlett's test of sphericity was significant ($\chi 2$ (10) = 728.01, $p <$

.001). Considering this, we assumed that the scale was appropriate for the analysis. A parallel

analysis indicated that four factors should be extracted. The variances accounted by the

second, third, and fourth factors were close to zero. This led to the interpretation that the

results of the parallel analysis indicated a one-factor structure. The scale has been shown by

previous studies to conform well to a one-factor structure and the conceptual definition

underlying the instrument assumes a unidimensional construct as well (Gouveia et al., 2009).

An exploratory factor analysis assuming one factor and adopting principal axis factoring as

the extraction method indicated a reasonable fit of the data. Factor loadings varied from .58 to

.81. We then computed a Bartlett score (Uluman & Doğan, 2016) as the main satisfaction

with life index. Higher scores represent higher levels of satisfaction with life. The instrument

presented acceptable levels of reliability in the present study ($\alpha = .81$; $\omega = .84$). Participants

reported their age, sex, and marital status by responding to socio-demographic questions.

Procedure.

Data was collected in groups of participants that voluntarily accepted to participate.

An informed consent was initially presented informing the participant about general issues

related to the research (i.e. the subject of the research; the anonymity and secrecy associated

with their participation; the fact that they could stop their participation whenever they

wanted). If participants agreed with the informed consent, they were presented to the

measures in the following order: Satisfaction with Life Scale, Five-item Mental Health Index,

UCLA Loneliness Scale (UCLA), Social Connectedness Scale (SCS), socio-demographic questions, pictorial measure of social connectedness (PC), and the abbreviated form of the Social and Emotional Loneliness Scale (SELSA). Participants were then thanked for their participation.

Data analysis.

Statistical analyses were performed using the R language and computational environment (R Core Team, 2017). The main dependent variables exhibited distributions that deviated considerably from a normal distribution. This was identified evaluating the Shapiro-Wilk test, histograms, values of kurtosis, and skewness. The Shapiro-Wilk test was statistically significant for all the variables, except for UCLA. Values of skewness and kurtosis were generally low, except for the scores representing romantic, family, and social loneliness.

We used different procedures to diagnose and deal with missing data. The Little's missing completely at random (MCAR) test indicates whether columns or rows in the dataset have more than 5% of missing data. It indicated that the dataset did not have any columns or rows with more than 5% of missing data. Only 0.789% of the total cells were missing values. The test for missing completely at random (MCAR) and Homoscedasticity from the MissMech package (Jamshidian, Jalal, & Jansen, 2014) indicated that there was not sufficient evidence to reject MCAR. We also created a dummy variable classifying participants in one of two categories: participants who had any missing value and participants who had no missing value. We used the Chi square test to evaluate if variables such as sex or marital status could influence the pattern of missing data shown by the dummy variable. The test indicated that none of the variables explained significantly the pattern of missing data. Together, this information indicates that missing data is probably random in our dataset and that we generally observed low levels of missing data. Considering this, we used the random

forest method for multiple missing data imputation by means of the missForest package

(Stekhoven & Buhlmann, 2012). Finally, we compared the descriptive statistics between the

original dataset and the dataset after data imputation. The descriptive statistics were almost

identical between datasets.

Results

The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .89. The Bartlett's

test of sphericity was significant ($\chi 2$ (105) = 6351.81, $p < .001$). A parallel analysis indicated

that three factors should be extracted. All the three factors presented eigenvalues higher than

1. An exploratory factor analysis assuming three factors, adopting principal axis factoring as

the extraction method and using oblimin as the rotation method indicated a reasonable fit of

the data. Factor loadings varied from .37 to .96. Three Bartlett scores were computed

(Uluman & Doğan, 2016) for each source of loneliness – romantic (R), familiar (F), and

social (S). Lower scores represent higher levels of loneliness in each domain. The three scores

exhibited acceptable levels of internal consistency ($\alpha = 0,92$-$0,93$; $\omega = 0,94$-$0,96$).

Table 4 exhibits the associations between the main variables in the form of

Spearman's Rho. Each of the SELSA scores exhibited a much smaller association with mental

health or satisfaction with life when compared to UCLA – approximately less than half the

size of associations between UCLA and mental health or satisfaction with life. Both social

connectedness measures exhibited a medium to large association with mental health and

satisfaction with life. Romantic loneliness exhibited low associations with most of the

variables. To run the multiple regression for the prediction comparison between the variables,

we evaluated the evidence regarding this techniques' assumptions. Multicollinearity is

probably not a major issue as all variables had VIF < 5 (max: 3.74). Linearity was

corroborated by the visual inspection of the normal Q-Q plot, the residuals versus fitted plot,

and the scale-location plot. The Durbin-Watson test for autocorrelated errors indicated that the assumption of independence of errors was also met ($DW = 1.84$, $p = .06$).

Table 4

Associations between the main variables.

Measure	1	2	3	4	5	6	7
1. Pictoric connectedness (PC)							
2. Connectedness (SCS)	.56**						
3. Loneliness (UCLA)	-.61**	-.82**					
4. Romantic loneliness (R)	.10**	.14**	-.21**				
5. Family loneliness (F)	.23**	.36**	-.32**	-.09			
6. Social loneliness (S)	.30**	.50**	-.47**	-.02	-.12		
7. Satisfaction with life	.38**	.50**	-.52**	.18**	.30**	.22**	
8. Mental health	.42**	.49**	-.58**	.13**	.32**	.21**	.52**

* indicates $p < 0.05$; ** indicates $p < 0.01$.

Figures 5 and 6 exhibit the relative importance of the predictors regarding mental health (Figure 5) and satisfaction with life (Figure 6) separately. The relative importance was estimated by two different methods of hierarchical partitioning of the coefficient of determination (R^2) (Chevan & Sutherland, 1991). The graph represents the percentage of the R^2 that is explained by each predictor in the regression in order of magnitude. The LMG method partitions the R^2 by averaging over orders of inclusion of the predictor in the model and the last method partitions the R^2 by considering the contribution of each predictor when included last in the model.
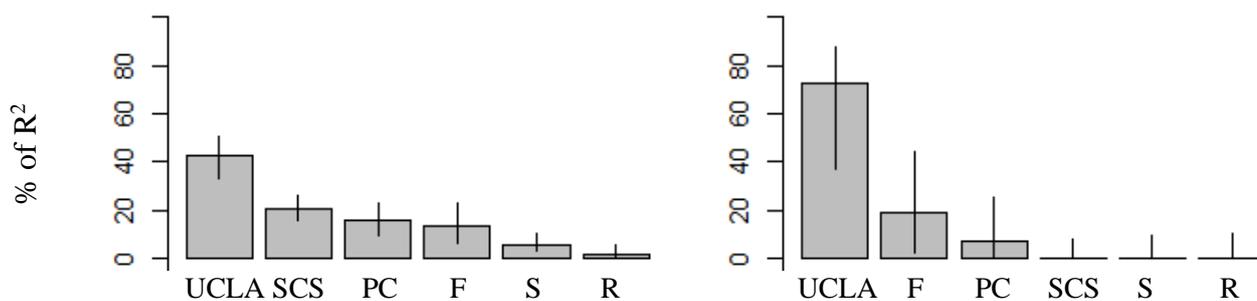
Figure 5: Relative importance of the predictors of mental health in terms of percentage of the R^2 ($R^2 = 36.2$) with 95% bootstrap confidence intervals. Left graph: LMG method; right graph: last method.
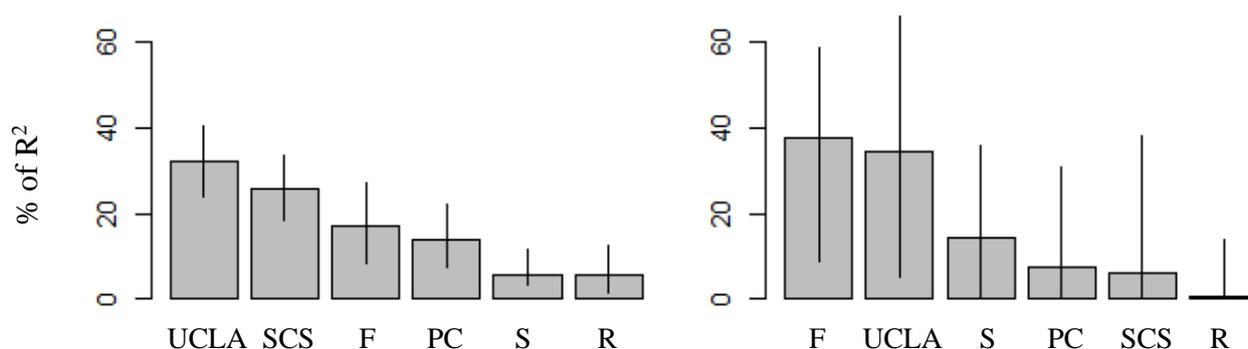

Figure 6: Relative importance of the predictors of satisfaction with life in terms of percentage of the R^2 ($R^2 = 32.2$) with 95% bootstrap confidence intervals. Left graph: LMG method; right graph: last method.

Generally, the UCLA was the most important predictor and romantic loneliness was the least important across criterion variables and partitioning methods. Figure 5 indicates that the main predictor of mental health using both methods is the UCLA, explaining from 40% to approximately 70% of the R^2. The LMG method indicates that the two measures of social connectedness (SCS and PC) also contribute considerably, but the other loneliness scores are less important except for the family loneliness (F) score that had a similar contribution compared to the social connectedness measures. The Last method shows that, except for F, the other loneliness scores from SELSA, just like scores from the SCS and PC, adds little contribution when included lastly in the model.

F contributes with 20% of R^2 in this situation. In Figure 6, the distance of the contribution of UCLA in comparison with the other predictors is considerably smaller than what is shown in Figure 5. For example, when considering the Last method, the most important predictor was F, followed by UCLA and S. The LMG method indicated that SCS had a contribution comparable to the contribution from UCLA, although UCLA was the most important predictor in this case too. F and PC also had considerable contributions that were not much smaller than the SCS's contribution.

To explore the bipolarity hypothesis, we converted the scores' cartesian factor loadings from all the connectedness and loneliness items (PC, SCS, SELSA, UCLA) into polar/angular coordinates and plotted them in a graph by means of the psych package (Revelle, 2017) (see Figure 7) following recommendations from previous authors (Rafaeli & Revelle, 2006). Three main clusters were observed in the graph: one cluster in the upper part of the vertical axis including items from the family loneliness dimension of the SELSA except for item 3; a second cluster in the right extreme of the horizontal axis including items from the SCS, the PC score, items from the loneliness and romantic dimensions of the SELSA, except for item 6, and item 14 from the UCLA; a third cluster including almost all the items from the UCLA; items 17 from the UCLA and 3 from the SELSA were not included in any of these clusters. The main cluster composed of UCLA items formed an approximately 180 degrees of angular separation with the cluster composed of SCS and SELSA items. As an attempt to verify the replicability of our findings in Study 3, we followed the same procedure just described but considering only the items from the SCS and UCLA, which can be observed in Figure 8. This graph generally indicated a greater dispersion in the patterns of clustering compared to Figure 8 with data points varying considerably their angular separation between one another.
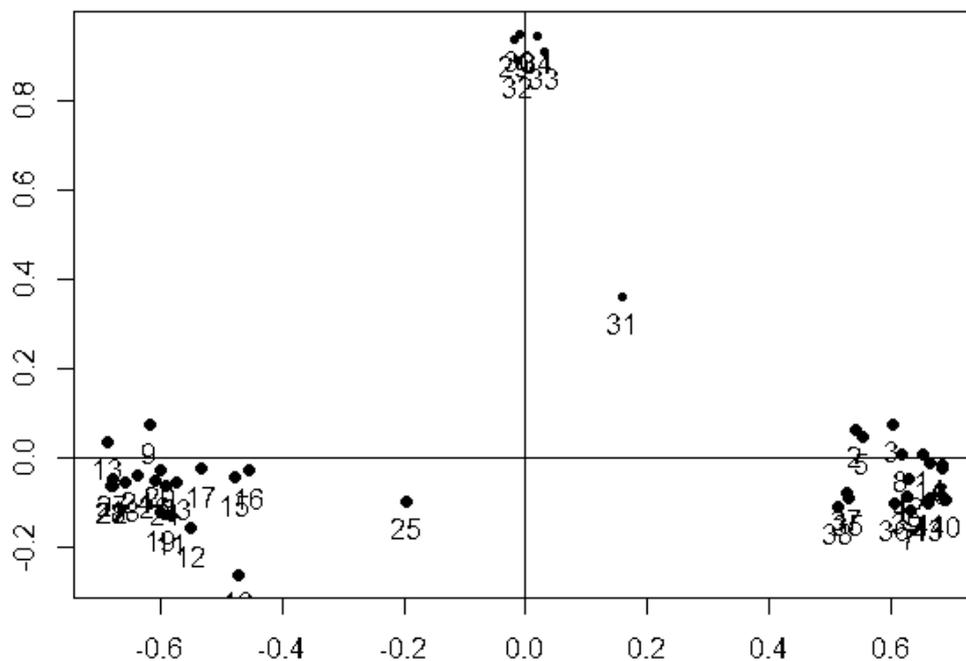
Figure 7: Angular separation of the items polar coordinates from the social connectedness and loneliness measures.

Note: Numbers associated with each variable in Figure 7: 1. SCS 1; 2. SCS 2 (r); 3. SCS 3 (r);4. SCS 4; 5. SCS 5, 6. SCS 6; 7. SCS 7; 8. PC; 9. UCLA 1 (r); 10. UCLA 2; 11. UCLA 3; 12. UCLA 4; 13. UCLA 5 (r); 14. UCLA 6; 15. UCLA 7; 16. UCLA 8; 17. UCLA 9 (r); 18. UCLA 10 (r); 19. UCLA 11; 20. UCLA 12; 21. UCLA 13; 22. UCLA 14; 23. UCLA 15(r); 24. UCLA 16 (r); 25. UCLA 17; 26. UCLA 18; 27. UCLA 19 (r); 28. UCLA 20 (r); 29. SELSA 1; 30. SELSA 2; 31. SELSA 3; 32. SELSA 4; 33. SELSA 5; 34. SELSA 6; 35. SELSA 7; 36. SELSA 8 (r); 37. SELSA 9; 38. SELSA 10; 39. SELSA 11; 40. SELSA 12; 41. SELSA 13; 42. SELSA 14; 43. SELSA 15. "(r)" means that the item had to be reversed because of its opposite meaning.

Four main clusters were identified: one cluster in the left part of the horizontal axis including item 6 (variable 13 in Figure 8 that is related to social connectedness) of the UCLA and the items from the SCS, except for item 3; a second cluster in the higher part of the vertical axis including items 2 and 4 of the UCLA (items related to loneliness); a third cluster including most of the items of the UCLA, except for items 1, 9, 16, and 10 (items related to social connectedness and extraversion) which formed a fourth cluster at the right extreme of the horizontal axis. Item 3 from the SCS did not cluster with any other item.
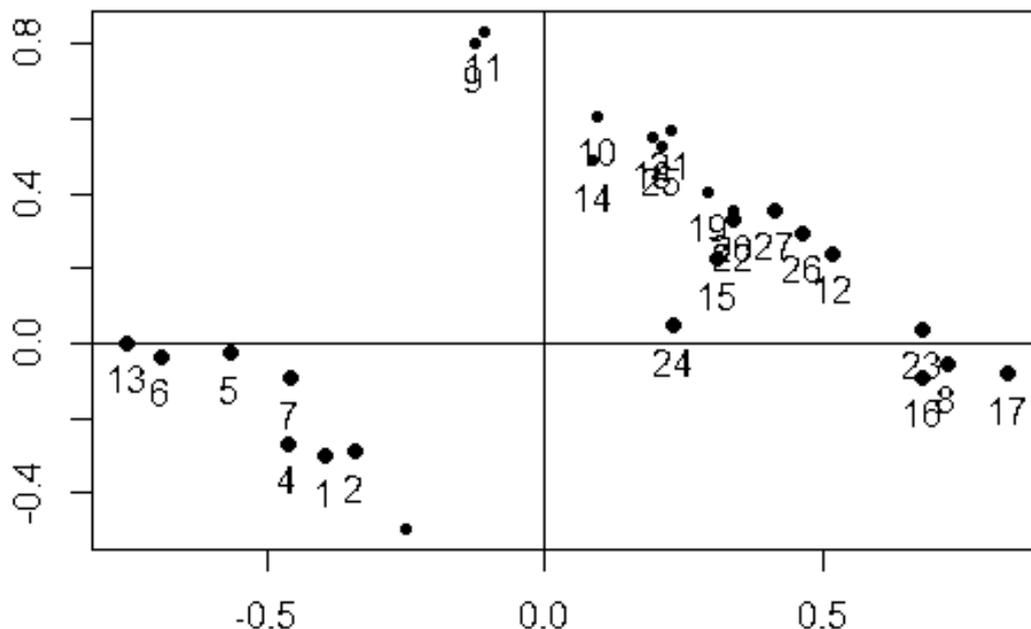
Figure 8: Angular separation of the items polar coordinates from the SCS and UCLA (variables 1 to 7 are the SCS items and 8 to 27 are the UCLA items).

Discussion

We could reach our goal by comparing the predictive importance of scores derived from different measurement procedures that assumes different mental representations of social connectedness and loneliness. Many of the results indicated by the hierarchical partitioning of the coefficient of determination are relevant to our worries about the UCLA's validity and to the discussion of the mental representation of the phenomena. One of the most interesting results is the comparison between the social loneliness scores (S) from the SELSA and the scores from the UCLA. Theoretically, both are supposed to capture a very similar construct, that is, the degree to which a person perceives a lack of satisfaction with its social relationships. Empirically, we observed a high coefficient of association (see Table 4) that was considerably higher than the coefficient of association among the UCLA and the other SELSA scores. Nevertheless, the S was one of the weaker predictors across criterion variables and regression partitioning methods just like romantic loneliness (R) while the UCLA was the stronger predictor. Contrary to the UCLA, the SELSA is based on an explicit conceptual

definition of loneliness and the items are clearly derived from the three assumed dimensions from a conceptual and empirical perspective as the results from the factor analysis reinforced. This makes the SELSA a superior instrument in comparison to the UCLA and a more easily interpretable and reliable measure of loneliness. In sum, when we compared two different measurement procedures to analyze the predictive power of loneliness on both mental health and satisfaction with life the results indicated that very different conclusions could be drawn from different measures. Considering the qualities of the SELSA and the problems of the UCLA, we assume that the conclusions derived from the SELSA are less ambiguous.

We have been arguing that despite the vast evidence supporting the validity of the UCLA there are very basic issues that are overly problematic in the instrument (see Study 3 in the present dissertation). The results from the present study are coherent with our hypothesis that the structure of the UCLA may maximize correlations with other variables because of measurement artifacts and not because of the "power" of loneliness. This is indicated here by the fact that a superior measure, regarding its development and interpretation (SELSA), presented a very different and weaker pattern of association with other variables. Both the social connectedness measures also generally presented a smaller association with the main criterion variables and were less important when the contributions from the different predictors were compared. What if the field of loneliness research had mainly used the SELSA instead of the UCLA? How impactful would that be to our current conclusions about the antecedents and consequences of loneliness (Cacioppo et al., 2011)? We believe that the answer to these questions, although unavailable, illustrate the importance of the problem that we are exploring and discussing here.

The relationship between the two social connectedness measures (SCS and PC) can be used as a relevant comparison criterion with the relationships between the loneliness measures (SELSA and UCLA). Even if the structure of the instrument and the assumed mental

representations are very different between the SCS and the PC, scores derived from both measures presented similar patterns of association with the other variables and a comparable relative importance as can be seen in Figures 5 and 6. This is an evidence of validity of both measures and is coherent with the view that both are measuring a similar construct assessed by different means but not the same construct, as their association was smaller than what we could expect if they were measuring the same construct, their contributions varied across estimation methods and predicted variables too. This may also mean that if people represent their social relationships using spatial metaphors of distance and closeness, this information may be integrated with verbal representations in a coherent way maybe because of people's awareness of their mental representations about relationships, but this conclusion demands additional investigation. Considering the similar predictive power of both measures, a major advantage of the PC is its brevity to answer and the visual intuitiveness of the judgment that is demanded from participants in comparison to the verbal structure of the SCS items.

A different situation can be observed when the relationship between the UCLA and the dimensions of the SELSA were analyzed (see Table 4). Even considering that the instruments have a similar general structure, as both are based on verbal stimuli and Likert-type response scales, the pattern of associations and the relative importance between them exhibited in Figures 5 and 6 is incoherent with the idea that both measure the same construct – loneliness. An important conclusion from this comparison is that mental health was much better predicted from the UCLA than from any of the SELSA's dimensions. Considering this result, if we were scientists mainly interested in the relationship between loneliness and mental health, maybe we could be led to very different conclusions depending on the measure that we adopted. We believe that a plausible explanation for this pattern of results is that the UCLA is overestimating the relationship between loneliness and mental health in comparison to the SELSA or other loneliness measures as a result of its conceptual looseness and the way

it was developed mainly based on the analysis of interviews with depressed patients (Russell et al., 1980).

The constellation of different constructs related to depression that ended up composing the contents of the UCLA items might have as an unintended consequence the higher probability of observing statistically significant and sizeable associations with depressive-related phenomena on any given study (see Study 3 for a detailed analysis of the content validity of the UCLA). As depression is a main antecedent and consequence of so many different variables (Cruwys et al., 2014b; Gotlib & Joormann, 2010; Monroe & Anderson, 2015), one possibility is that this validity confound in the UCLA may overestimate the relationship between loneliness and many variables other than mental health. One might argue: "then why isn't the relationship between the UCLA and mental health even bigger?". Although the constellation of constructs present in the UCLA content are frequently related in different ways to depression, most of the core symptoms of depression are not present in the content of the UCLA items, such as negative affect, hopelessness, and lack of joy in pleasurable activities (Gotlib & Joormann, 2010; Monroe & Anderson, 2015) so it makes sense that measures of depression and loneliness do not correlate perfectly but only strongly.

In sum, although it is not reasonable to argue that the UCLA is itself a measure of depression or core depressive symptoms, we argue that the UCLA unwillingly measures different constructs that are commonly related to depressive symptoms, such as social support, social connectedness, shyness, and loneliness, thus overestimating the conclusions regarding the impact of loneliness on mental health due to the unidimensional interpretation of scores derived from this measure that are usually understood as reflecting only global loneliness and measurement error (Cramer & Barry, 1999). We believe that this interpretation is more warranted than the opposite because while both the UCLA and SELSA have favorable evidence regarding their psychometric qualities, the SELSA has a clear conceptual

foundation for a proper interpretation of the instrument while the UCLA has not. Because of this, we believe that conclusions about loneliness derived from the use of the SELSA are probably less ambiguous than conclusions derived from the UCLA and this means that the literature is possibly suffering from an inflation of associations between loneliness and diverse health and psychological variables.

Another relevant result was the importance of the familiar loneliness (F) dimension of the SELSA. Among SELSA's three dimensions, F was the most important predictor of both mental health and satisfaction with life. It was an even stronger predictor of satisfaction with life than the UCLA in one of the hierarchical partitioning methods adopted here (the last method). One possible theoretical implication of this result is that not all social domains are equally impactful on people's mental health and satisfaction with life but rather the social connectedness with one's own family might be the most important social sphere in comparison to the others as the CLM suggests (see Study one in the present dissertation). From an evolutionary and developmental perspective, this conclusion is coherent as family members are the most genetically related members of a person's life and from the perspective of the "selfish gene", they are the most important people in the beginning of life as human babies are extremely dependent on caretakers and will receive most of the affect and support from their family (Baumeister & Leary, 1995). Family members are usually the people with whom one is more likely to rely and receive support when needed throughout one's development. They are also the first people with whom a person develops attachments that can determine the pattern of social relationships establishment that one is likely to reproduce later in life in their relationships (Baumeister & Leary, 1995; Carvallo & Gabriel, 2006).

One of the main methodological issues is that we did not use any method to decrease the probability of order effects such as counterbalanced presentation of the scales and items. Even using methods such as counterbalance is no guarantee that a study is free from such

biases, but the lack of any attempt to minimize this is a limitation of our study. Our research design also do not allow us to conclude any causality between the variables under investigation, an information that would be very informative for theoretical and practical reasons such as intervention planning (Cacioppo, Grippo, London, Goossens, & Cacioppo, 2015). Finally, our results are silent regarding the possible complex and dynamic interactions across time between the variables that we measured and longitudinal studies would add crucial information for the kind of conclusions that we have drawn in the present study.

Future studies could contribute to the present study by comparing other measurement procedures that assume different mental representations of social connectedness and loneliness. This could be achieved by including multidimensional measures assuming different numbers of dimensions such as the LACA (Maes et al., 2015) or implicit measures (Petty et al., 2009). In the case of the LACA, it would be better to have a version for adults so it could be compared with most the loneliness measures, which are usually focused on adults. Implicit measures have poorly been explored in the study of these topics and could add important contributions to the understanding of social connectedness and loneliness.

Study 6: The Effect of Social Connectedness on Measures of Social Connectedness,

Loneliness, and Satisfaction with Life

It is widely proposed by scientists that the fundamental social motives resulting from our evolutionary history shape many of our actions and thinking (Kenrick, Neuberg, Griskevicius, Becker, & Schaller, 2010). The need to belong is considered particularly important due to its potential to be one of the paths to satisfy many of the other basic social motives (Baumeister, 2012; Neel et al., 2016). It refers to the fact that people are generally motivated to engage in meaningful and long-lasting relationships with others (Baumeister & Leary, 1995). By satisfying the need to belong, or by otherwise not doing so, there are, respectively, two possibilities that individuals may experience: social connectedness or loneliness.

Many authors regard (implicitly or explicitly) that these two types of experience are opposite concepts. When people satiate their need to belong, they feel socially connected and integrated; if weakly satiated, they feel lonely and isolated. We have developed a criticism of such assumption due to its conceptual and empirical lack of justification (see Studies 1 and 3 in the present dissertation). The connectedness and loneliness model (CLM) emerged from this criticism as an attempt to offer an explicit, integrated, and updated understanding of the experiences of connectedness and loneliness and what could be expected about their relation between each other and with other constructs (see Study 1 in the present dissertation). An advantage of this model is its greater generative power compared to alternative conceptual proposals. That facilitates hypothesis-testing driven studies and cumulative model improvement. To begin with the empirical exploration of this model, it is important to establish a valid experimental operationalization that could be used in different studies to test hypothesis derived from the CLM. Specifically, an experimental manipulation would allow us to test the separate effects predicted by the CLM of the emotional intensity and emotional

valence of the experience of connectedness or loneliness on health and social receptivity. Given the fact that we were not able to find any social connectedness manipulation in Brazilian Portuguese, our decision was to adapt one. The goal of the present study was to test the effect of a social connectedness manipulation on measures of social connectedness, loneliness, and satisfaction with life.

Prompting Social Connectedness

Social connectedness has been operationalized as an experimental manipulation in multiple ways (Chatterjee, Baumann, & Osborne, 2013; Cwir et al., 2011; DeWall, Baumeister, & Vohs, 2008; Epley & Schroeder, 2014; Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Gebauer & Maio, 2012; Hutcherson et al., 2008; Inagaki & Eisenberger, 2013; Lambert et al., 2013; Lucas & Livingston, 2014; Pavey, Greitemeyer, & Sparks, 2011; Sandstrom & Dunn, 2014; Walton & Cohen, 2011; Walton, Cohen, Cwir, & Spencer, 2012; Waytz & Epley, 2012). These manipulations tasks can be categorized in three main types of tasks that vary across studies: 1) meditative practice; 2) imaginative practice; 3) direct social interaction. The basic idea underlying these manipulations is to make people remember or feel temporary positive feelings of bonding toward other people, especially close ones but also unknown people in the case of direct social interaction.

As criteria for choosing a specific operationalization for the present study, we considered that the manipulation should involve a simple, fast, and viable task that also was coherent with the conceptualization proposed by the connectedness and loneliness model (see Study 1 of the present dissertation) and that would enable us to viably collect data with a large sample to increase reliability of our conclusions (Button et al., 2013). Direct social interaction was excluded as a possibility because it would demand confederates available to participate in the task, which could make the data collection costlier, less efficient, and is usually a task more focused on stimulating a positive social interaction with an unknown people than a

sense of social connectedness properly. This experimental situation would be too different from the conceptualization of the model in comparison to the other options. Although meditative practice is apparently a more intense and possibly stronger manipulation than imaginative practice it usually is more time consuming and could be more susceptible to individual differences in attentional and motivational processes (Chiesa, 2010; Eberth & Sedlmeier, 2012). Considering these trade-offs, we opted to use an imaginative practice that is described with more details in the method section.

Social connectedness is associated with different psychological variables such as well-being, happiness, health, and positive affect (S. Cohen, 2004; Detrie & Lease, 2007; Jose et al., 2012; Lee et al., 2008; Reis et al., 2000; Resnick, Harris, & Blum, 1993; Seppala et al., 2008; Woolley, Kol, & Bowen, 2008; Yoon, Lee, & Goh, 2008). Considering the accumulated evidence documenting the relationship between social connectedness and well-being, it might be a suitable candidate for a dependent measure to estimate the magnitude of impact of the experimental manipulation. That is, considering the prior evidence indicating the strong association between these variables, it is reasonable to expect that an intervention capable of increasing social connectedness could influence one's well-being. The same reasoning would apply for happiness, health, or positive affect and we are not aware of any reason why one of these constructs would be preferable to the others. For that reason, we chose well-being as the main dependent measure to estimate the effect size of this experimental manipulation.

As an additional test of validity for this experimental manipulation, we also included two different measures of social connectedness and loneliness to strengthen our confidence in the validity of the experimental procedure for future use in studies exploring the connectedness and loneliness model. These measures will allow us to explore the mental representation of these phenomena (see Study 1 in the present dissertation for further

discussion of this aspect) through different kinds of measurement procedures and the results might indicate to us what specific aspects of social connectedness are more stimulated by the experimental manipulation. One of these measures, the Loneliness Implicit Association Test (L-IAT) (Campelo & Pilati, 2017), will also allow us to initially explore loneliness at an implicit level, an emergent topic that has not yet received attention from the field of social psychology and that was pointed out in Study 1 as a possibly important matter to be further studied. Finally, we will be able to investigate the bipolarity hypothesis (see Study 3 in the present dissertation) regarding the relationship between social connectedness and loneliness and compare the predictive power of different measurement procedures of these variables. By doing these things we will be able to extend the conclusions from the previous investigations of the present dissertation and evaluate their replicability, a pressing issue increasingly emphasized by the scientific community (Asendorpf et al., 2013; Braver, Thoemmes, & Rosenthal, 2014; Maxwell, Lau, & Howard, 2015).

We formulated five hypothesis to be tested in the present experiment: 1) participants in the social connectedness condition will exhibit higher satisfaction with life than participants in the control condition; 2) participants in the social connectedness condition will exhibit higher social connectedness as indicated by the social connectedness scale (SCS) than participants in the control condition; 3) participants in the social connectedness condition will exhibit higher social connectedness as indicated by the pictorial measure of social connectedness (PC) than participants in the control condition; 4) participants in the social connectedness condition will exhibit lower loneliness as indicated by the social and emotional loneliness scale (SELSA) than participants in the control condition; 5) participants in the social connectedness condition will exhibit lower loneliness as indicated by the Loneliness Implicit Association Test (L-IAT) than participants in the control condition. We emphasize that the hypotheses generated here are not specifically tied to any theoretical assumption or

prediction of the CLM, but instead are associated with the evidence presented previously about the relationships between social connectedness and well-being. Additionally, as a simple manipulation check, it is reasonable to expect that a manipulation of social connectedness should impact measures of social connectedness and loneliness, so we included measures of both for additional sources of evidence of its validity. After observing favorable evidence about the validity of this manipulation in the present study, future studies may use it to test hypothesis generated from the CLM.

Method

Participants.

The sample was composed of 224 university students (122 women and 102 men) with mean age of 20,29 (*SD* = 2,93). The participants were mainly single (N = 141), in a serious relationship (N = 80), or married (N = 2) (widower: 1) and mostly undergraduates (N = 183) or had completed secondary education (N = 27) (graduate: 8; master's degree: 4; incomplete secondary education: 1; specialization: 1). Finally, the sample was overall composed of students (N = 185), employees (N = 16), and unemployed (N = 13) (freelancer = 9; retired = 1). An estimation of the sample size was made by using the pwr package assuming a power of .80 with an alpha value of .05 and at least an expected effect size of .63 for a t-test. The effect size was based on the original study from Livingston and Lucas (2014) considering that this is the only available estimate of such effect size. The power analysis indicated a necessary total sample of 80 participants.

Instruments and materials.

Social connectedness manipulation.

We adopted a cognitive task used in two previous studies to stimulate social connectedness (Lucas & Livingston, 2014; Waytz & Epley, 2012). We specifically translated and adapted the instructions used by Lucas and Livingston by means of the back-translation

and committee methods (Cha et al., 2007). Participants in the social connectedness condition received the following instruction, which was presented in a computer screen: "Nós gostaríamos que você pensasse sobre alguém com quem você atualmente sente que tem uma relação próxima. Pare para pensar sobre como estar com esta pessoa faz você se sentir. Por favor, escreva sobre uma vez que fez você se sentir especialmente próximo (a) desta pessoa. O que aconteceu? Como você se sentiu? [Think about someone with whom you currently feel like you have a close relationship. Take a moment to think about how being with this person makes you feel. Please write about a time that made you feel especially close to this person. What happened? How did you feel?]". Participants in the control condition received the following instruction: "Nós gostaríamos que você pensasse sobre alguém que você já viu antes ou com quem já esteve em breve contato, mas com quem você não está familiarizado – você não conhece bem essa pessoa. Alguns exemplos de tal pessoa poderiam ser alguém que trabalha na lanchonete da qual você compra comida, mas com quem nunca conversou direito. Ou alguém que você vê em sala de aula ou perto do seu trabalho, mas com quem nunca falou. Embora você não saiba muito sobre essa pessoa, por favor, escreva sobre ele ou ela. Como você acha que é a personalidade dessa pessoa? Como você acha que seria passar um tempo com essa pessoa? [We would like you to think about someone you have seen before or been in brief contact with, but who you are not acquainted with, i.e. you do not know this person well. A few examples of such a person might be the person who works at the coffee shop that you buy coffee from, but have never had a full conversation with. Or a person who you see in class or around your office but have never spoken with. Even though you do not know much about this person, please write about him or her. What do you think this person's personality is like? What do you think it might be like to hang out with this person?]". After that, participants should type their thoughts about the situation stimulated by the instructions and they were free to take as much time as they wanted in this task.

Self-report measure of social connectedness.

We used the adapted version (see Study 2 in the present dissertation and Appendix 1) of the social connectedness scale (Lambert et al., 2013). It is a seven-item scale measuring the subjective experience of belonging in a unidimensional factor structure. There are five response options varying from "totally disagree" to "totally agree". The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .76, which can be considered acceptable and the Bartlett's test of sphericity was significant ($\chi2$ (21) = 267.67, $p < .001$). The communalities between the items were all above .58. Considering this, we assumed that the scale was appropriate for the analysis. A parallel analysis indicated that three factors should be extracted. The variance accounted by the second and third factors was close to zero and below .5 so we interpreted the results of the parallel analysis as indicating a likely one-factor structure. We were even more confident of this decision considering that the scale has been shown by previous studies to conform well to a one-factor structure (see all the previous studies in the present dissertation) and that the conceptual definition underlying the instrument assumes a unidimensional construct. An exploratory factor analysis assuming one factor and adopting principal axis factoring as the extraction method indicated a reasonable fit of the data. Factor loadings varied from .44 to .65 and the factor accounted for 74% of the variance. We then computed a Bartlett score (Uluman & Doğan, 2016) as the main social connectedness index. Higher scores represent higher levels of social connectedness. The evidence of reliability in the present research was acceptable ($\alpha = .73$; $\omega = .80$).

Pictorial measure of social connectedness.

The pictorial measure of social connectedness (see Study 4 in the present dissertation and Appendix 7) was used. Participants were presented to seven options of images representing the closeness between them and people in general. Each image exhibited two circles with different degrees of physical proximity and the options varied regarding how

close the circles were spatially disposed. The label "You" was presented beneath the smaller circle in the left while the label "People" was presented beneath the bigger circle in the right. The images varied from a disposition where two circles were distant from one another to a disposition in which the smaller circle was completely inside the bigger circle. Participants received the following written instruction in the beggining of the task: "Por favor, marque um "X" no quadrado ao lado da imagem que melhor descreve a proximidade entre você e as pessoas de modo geral. " There is favorable evidence of its test-retest reliability and validity (see Study 4 in the present dissertation).

Social and emotional loneliness scale (SELSA).

The adapted version of the abbreviated Social and Emotional Loneliness Scale (SELSA) was used (Cramer et al., 2000) (see Appendix 9). It is a measure of the aversive experience of loneliness considering three different types of experience that emerge from the perceived deficit in one interpersonal dimension (romantic, familiar, or social). It is a multidimensional scale composed of fifteen items with five possible response options varying from "discordo totalmente" ("totally disagree") to "concordo totalmente" ("totally agree"). The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .87, which can be considered acceptable and the Bartlett's test of sphericity was significant ($\chi2$ $(105) = 2644.87$, $p < .001$). Considering this, we assumed that the scale was appropriate for the analysis. A parallel analysis indicated that three factors should be extracted. All the three factors presented eigenvalues close to 2 or higher. An exploratory factor analysis assuming three factors, adopting principal axis factoring as the extraction method and using oblimin as the rotation method indicated a reasonable fit of the data. Factor loadings varied from .40 to .97 (romantic: $R^2 = .97$; familiar: $R^2 = .93$; social: $R^2 = .88$). We then computed three Bartlett scores (Uluman & Doğan, 2016) for each source of loneliness – romantic, familiar, and social. Lower scores represent higher levels of loneliness in each domain. It presented acceptable

reliability in the present study (social: $\alpha = .87$, $\omega = .90$; family: $\alpha = .88$, $\omega = .91$; romantic: $\alpha = .93$ $\omega = .95$).

Loneliness Implicit Association Test (L-IAT).

The Loneliness Implicit Association Test (L-IAT) was used (Campelo & Pilati, 2017). It is a measure of how strong is the association between the self-concept and the concept of lonely as compared to the concept of not-lonely. Participants were asked to classify words appearing in a screen as belonging to one of two or one of four categories presented in the superior corners of the screen depending on the block of the task. The following categories and words in parenthesis were used in the task: "Solitário" ("Isolado", "Deslocado", "Abandonado", "Sozinho", "Desamparado", "Excluído", "Desconectado", "Desacompanhado"), "Não-solitário" ("Acolhido", "Amado", "Incluído", "Apoiado", "Querido", "Conectado", "Sociável", "Acompanhado"), "Eu" ("Eu", "Mim", "Meu", "Minha", "Eu mesmo"), and "Não-eu" ("Eles", "Elas", "Deles", "Outros", "O outro"). The task followed the same structure of blocks and trials of the standard Implicit Association Test (A. G. Greenwald, McGhee, & Schwartz, 1998) and the D score was computed using the standard D-scoring algorithm (A. G. Greenwald, Nosek, & Banaji, 2003) implemented in the IAT package (Martin, 2016). The L-IAT presented acceptable evidence of test-retest reliability when the two halves of the task were correlated ($r = .52$, $p < .001$, 95% CI [.41, 0.61]).

Satisfaction with life.

The Portuguese version of the Satisfaction with Life Scale (SWL) was used (Gouveia et al., 2009) (see Appendix 6). This five-item scale captures the domain-free global assessment about one's satisfaction with life. There are seven possible responses that vary from "discordo totalmente" ("totally disagree") to "concordo totalmente" ("totally agree"). The Kaiser-Meyer-Olkin test of sampling adequacy was equal to .75, which can be considered acceptable and the Bartlett's test of sphericity was significant ($\chi2 (10) = 229.65$, $p < .001$).

Considering this, we assumed that the scale was appropriate for the analysis. A parallel analysis indicated that one factor should be extracted. An exploratory factor analysis assuming one factor and adopting principal axis factoring as the extraction method indicated a reasonable fit of the data. Factor loadings varied from .42 to .81 and the factor accounted for 80% of the variance. We then computed a Bartlett score (Uluman & Doğan, 2016) as the main satisfaction with life score. Higher scores represent higher levels of satisfaction with life. The scale presented acceptable reliability ($\alpha = .72$; $\omega = .79$). Participants reported their age, sex, marital status, education, and employment situation by responding to socio-demographic questions.

Procedure.

Data collection occurred collectively in an informatics laboratory that was reserved for the conduction of the study. Participants read and signed an informed consent term to participate in the study. The informed consent term described the goal of the study and the fact that the study was voluntary, anonymous, and that participants could end their participation at any time they wanted. After that, they were randomly assigned by a software (Inquisit) to one of the two conditions: social connectedness condition or control condition. They should do the cognitive task related to their condition in a computer and raise their hands when they were finished (this instruction was presented in the screen). Finally, participants answered the following instruments: SWL, PC, L-TAI, SCS, SELSA, and the socio-demographic questions.

Data analysis.

Data analysis was implement by the language and computational environment R (R Core Team, 2017). Missing data was not a main problem in the present research, as most of the instruments were presented using the Inquisit software and it did not allow progress in the research if any items were unanswered. The only exception to that was the SWL and the PC,

which were presented in a sheet of paper after the manipulation due to difficulties in including them in the Inquisit syntax. Only 0.267% of the total cells were missing values. One participant did not answer the item 5 of the SWL, representing 0,4% of missing data in this variable, and five participants did not answer the PC, representing 2% of missing data in this variable. Both percentages represent very low indices of missing data. As some of the planned analyses demand datasets with complete cases, we used the non-parametric random forest method for multiple data imputation by means of the missForest package (Stekhoven & Buhlmann, 2012).

Results

The univariate and multivariate normality of the distribution of scores derived from the measures were evaluated by different methods such as the Shapiro-Wilk test, histograms, values of kurtosis, and skewness. The Shapiro-Wilk test was statistically significant for all the variables. Values of skewness and kurtosis were generally low, except for romantic loneliness, which presented kurtosis equals to -1.43 and social loneliness which presented a skewness equals to -1.26. Both Mardia's, Henze-Zirkler's, and Royston's multivariate normality tests indicated that the main aggregated scores deviated considerably from the multivariate normality (the package MVN was used to run these tests, Korkmaz, Goksuluk, & Zararsiz, 2014). Considering that the variables generally preserved univariate normality but did not preserve multivariate normality, we considered appropriate to use parametric and non-parametric techniques in the analysis according to the assumptions of each technique that were corroborated. The correlation coefficients between the variables can be seen in Table 5.

The Wilcoxon rank sum test with continuity correction was used to test the effect of the experimental manipulation by means of the stats package (R Core Team, 2017). Effect sizes were estimated by the Cliff 's Delta method (Macbeth, Razumiejczyk, & Ledesma, 2011) by means of the effsize package (Torchiano, 2017). Cliff 's Delta is a more appropriate

alternative to estimate the effect size especially when data is ordinal, do not follow a normal distribution, and is obtained by means of Likert scales. It is a non-parametric method that provides the "probability that a value selected from one of the groups is greater than a value selected from the other group, minus the reverse probability" (p. 547, Macbeth et al., 2011) . Values of 1, whether negative or positive, indicate no overlap between groups and values of 0 indicates complete overlap and identical distributions between groups. The descriptive statistics of the experimental groups can be seen in Table 6.

Table 5

Associations Between the Main Variables

Measure	1	2	3	4	5	6
1. L-IAT						
2. Pictoric connectedness (PC)	-.19**					
3. Connectedness (SCS)	-.19**	-.48**				
4. Romantic loneliness (R)	-.02	.03	.18**			
5. Family loneliness (F)	-.12	.17**	.53**	>.001		
6. Social loneliness (S)	.13*	.23**	.43**	>.001	-.01	
7. Satisfaction with life	-.17**	.21**	.45**	.17*	.35**	.26**

* indicates $p < 0.05$; ** indicates $p < 0.01$.

The average rank of the experimental group was not statistically significantly higher than the average rank of the control group for all the dependent variables IAT: $W = 6625$, $p = $ -.06, *delta* = .17, 95% CI [-0.08, 0.187]; pictorial connectedness (PC): $W = 6036$, $p = .62$, *delta* = -.04, 95% CI [-4.04, 2.82]; social connectedness (SCS): $W = 6359$, $p = .85$, *delta* = .01, 95% CI [-0.28, 0.34]; romantic loneliness (R): $W = 6284.5$, $p = .97$, *delta* = .003, 95% CI [-0.22, 0.23]; family loneliness (F): $W = 6247.5$, $p = .97$, *delta* = -.003, 95% CI [-0.27, 0.23]; social loneliness (S) $W = 5835.5$, $p = .37$, *delta* = -.07, 95% CI [-0.33, 0.07]; satisfaction with

Table 6

Descriptive Statistics for Each Experimental Group Regarding the Dependent Variables

Measure	Experimental N = 109	Control N = 115
1. L-IAT	-0.32 (0.49)	-0.28 (0.47)
2. Pictoric connectedness (PC)	3.85 (1.34)	3.79 (1.33)
3. Connectedness (SCS)	-0.04 (1.22)	0.04 (1.10)
4. Romantic loneliness (R)	0.00 (0.99)	0.00 (1.04)
5. Family loneliness (F)	0.00 (1.07)	0.00 (1.01)
6. Social loneliness (S)	0.08 (0.99)	-0.08 (1.14)
7. Satisfaction with life (SWL)	0.05(1.15)	-0.05 (1.10)

life: $W = .58$, $p = .37$, *delta* $= -.07$, 95% CI [-0.45, 0.18]). All the confidence intervals

included zero and almost all Cliff's Deltas were close to zero, except for the effect on the L-

IAT.

Considering that the experimental manipulation had no considerable effect on the

dependent variables, we concluded that it would be justifiable to compare the relative

importance of them in predicting satisfaction with life disregarding the experimental group of

the participants. This comparison was made by a multiple regression after the statistical

assumptions were verified. No evidence of multicollinearity was observed as all predictors

presented VIF < 5, (max: 2.49). The assumption of linearity was supported by the visual

inspection of the normal Q-Q plot, the residuals versus fitted plot, and the scale-location plot.

The Durbin-Watson test for autocorrelated errors indicated that the assumption of

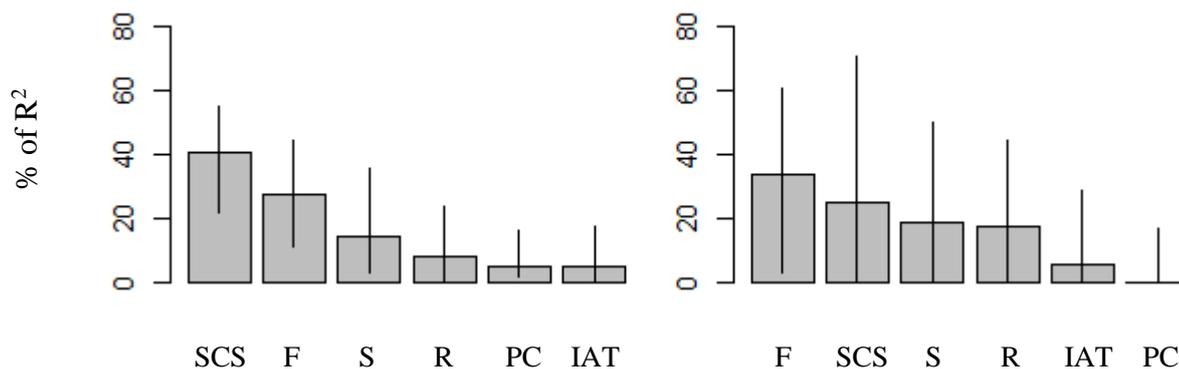independence of errors was also met ($DW = 2.03$, $p = .83$).

Figure 9. Relative importance of the predictors of satisfaction with life in terms of percentage of the R^2 (R^2 = .26) with 95% bootstrap confidence intervals. Left graph: LMG method; right graph: Last method.

The regression model explained 26% of the variance in satisfaction with life (R^2 = .26) and presented a statistically significant fit (F (6, 217) = 12.4, $p < .001$). Figure 9 shows the relative importance of the predictors of satisfaction with life. Relative importance was estimated using two different methods of hierarchical partitioning of the coefficient of determination (R^2) (Chevan & Sutherland, 1991). Both graphs represent the percentage of the R^2 that is explained by each predictor in the regression in order of magnitude. The LMG method partitions the R^2 by averaging over orders of inclusion of the predictor in the model and the Last method partitions the R^2 by considering the contribution of each predictor when included last in the model. In both graphs, SCS and F were the strongest predictors while IAT and PC were the weakest predictors. S and R presented medium to low sized contributions in both cases.

To further explore the bipolarity hypothesis regarding social connectedness and loneliness (see Study 3 in the present dissertation), we plotted the angular separation between the polar coordinates of the items of SCS, SELSA, the PC score, and the IAT score as can be seen in Figure 10. To do this, we followed recommendations from previous authors (Rafaeli & Revelle, 2006). Table 8 identifies which variables are associated with which numbers in Figure 2. The graph presents three main clusters: one around the upper part of the vertical axis

which includes items from the romantic loneliness dimension of SELSA except for item 8; a second cluster in the right part of the horizontal axis which includes three items from SCS, all the four items from the social loneliness dimension of SELSA, and the PC score; a third cluster in the right end of the horizontal axis which includes three items from the family loneliness dimension of SELSA and one item from the SCS. This item (item 7) is the one in the SCS that refers to the social connectedness associated with the person's family. Finally, five variables did not cluster with other variables and the IAT score formed an angular separation of approximately 180 degrees with the second and third cluster mentioned.
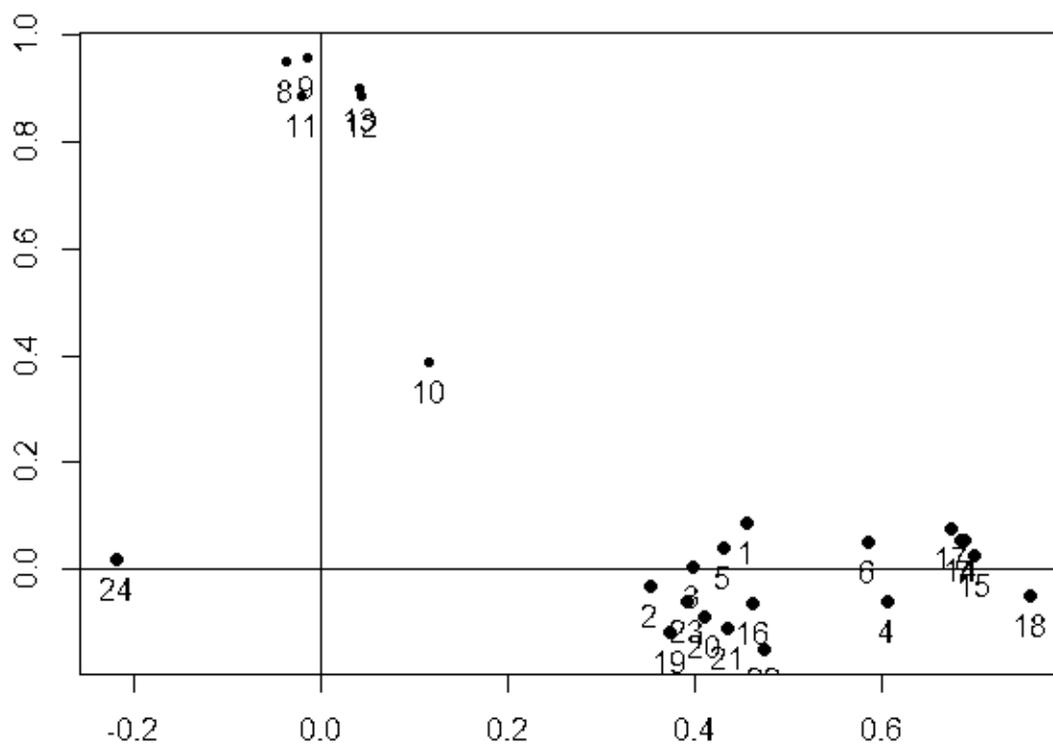
Figure 10. Angular separation of the SCS, PC, SELSA, and IAT items polar coordinates.

Note: Numbers associated with each variable in Figure 10: 1. SCS 1;2. SCS 2 (r); 3. SCS 3 (r);4. SCS 4; 5. SCS 5, 6. SCS 6; 7. SCS 7; 8. SELSA 6; 9. SELSA 7; 10. SELSA 8 (r); 11. SELSA 9; 12. SELSA 10; 13. SELSA 11; 14. SELSA 1; 15. SELSA 2; 16. SELSA 3; 17. SELSA 4; 18. SELSA 5; 19. SELSA 12; 20. SELSA 13; 21. SELSA 14; 22. SELSA 15; 23. PC; 24. IAT. "(r)" means that the item had to be reversed because of its opposite meaning.

Discussion

The main goal of the present experiment was to test the effect of a social connectedness manipulation on satisfaction with life, social connectedness, and loneliness. We were also interested in extending the findings from the previous studies in the present dissertation and evaluate their replicability. The main conclusion of the study was that the social connectedness manipulation that we used had no observable effect on the dependent variables. All the confidence intervals included zero and the fact that almost all Cliff's Deltas were close to zero indicate that the distributions of the two groups overlapped almost completely for all dependent variables. There are at least two main plausible explanations for that. One possibility is that we should not have expected to observe an effect on the dependent variables because they are not so easily influenced by situational factors, that is, they have strong stability. At least in the case of the SCS, previous experiments used it as a manipulation check for a social connectedness manipulation similar to ours and the groups did significantly differ in their scores (Lambert et al., 2013) so, in principle, we believe that this hypothesis do not apply necessarily to some of the measures.

Another possibility is that the previous studies using this manipulation or a very similar variation of it (Lucas & Livingston, 2014; Waytz & Epley, 2012) observed a significant effect due to questionable research practices such as post-hoc hypothesis adjustments, p-hacking, or other inappropriate data analysis procedures which can have as one consequence a lower replicability of the effects (John, Loewenstein, & Prelec, 2012; Nosek, Spies, & Motyl, 2012). It is true that our study is not an attempt of direct replication of any of the studies mentioned before, but if a social connectedness manipulation was able to impact different phenomena such as dehumanization and moral judgment, it is reasonable to expect that this happened because of temporarily generated experiences of social connectedness which influenced the subsequent cognition and behavior of participants. If this is what happened, then this increased social connectedness should in principle manifest itself at some

level in the scores derived from an appropriate measure of social connectedness and this did not happen in our study. Although it has been argued that such questionable research practices are common in different areas of psychology, we are not aware of any concrete evidence regarding studies of social connectedness or the studies that we cited so this question remains unanswered.

The comparison of relative importance of the predictors of satisfaction with life indicated that both social connectedness as measured by SCS and the family dimension of SELSA were the most important predictors in two different methods of estimation of the comparison. This result sum up to previous studies in the present thesis indicating that scores derived from the SCS are usually good predictors of satisfaction with life and that the family dimension of the SELSA is the most important factor of the scale in comparison to the other dimensions (see Studies 4 and 5 in the present dissertation). This also corroborates some of the propositions in the connectedness and loneliness model (CLM) (see Study 1 in the present dissertation), such as the importance of the family as a source of connectedness. This hierarchy of importance between the dimensions also corroborates the importance of conceptualizing loneliness as a multidimensional construct, another strongly held assumption of the CLM. Future studies should test the validity of other experimental manipulation procedures such as those described in the introduction of the present study. To fully explore many of the CLM assumptions and implications, it is of fundamental importance to establish valid and replicable experimental manipulations. The present study was an initial attempt in this direction and we encourage other scientists to evaluate the replicability of the experimental manipulation procedures available in the literature.

General Discussion

The present dissertation had the goals of critically reviewing the literature that investigates social connectedness and loneliness, especially regarding the conceptualizations and measurement procedures that have been mostly used in the field of social psychology, propose an alternative model that synthesizes current knowledge and suggest new directions for conceptualizing social connectedness and loneliness – the connectedness and loneliness model (CLM) –, and to begin the empirical exploration of some of the assumptions and implications derived by the critical review and the CLM. We believe that these goals have been reached in innovative and suggestive ways that may contribute to the advancement of the field.

The development of six studies using a variety of different scientific methods have provided different sources of evidence that raise questions about many aspects of the way social connectedness and loneliness have been investigated in social psychology for the last decades. One of the most concerning conclusions that is coherent with our data is that the most widely used instrument to measure loneliness in the field of social psychology, the UCLA Loneliness Scale, appears to suffer from basic problems that raise concerning doubts about its validity (Cramer & Barry, 1999; Messick, 1995). This conclusion raises doubts too about many of the claims that have been made about loneliness lately (J. T. Cacioppo et al., 2011; S. Cacioppo et al., 2015). We believe that more importance should be given to investigations about the validity of the measures being used in the field of social psychology.

Another alarming matter corroborated by our studies is that using different types of loneliness measurement procedures can lead one to highly distinct conclusions about the relationships of loneliness with other variables. Comparing this observation with what we could conclude about the relationship between different types of social connectedness measurement procedures led us to think that something problematic about the measures of

loneliness is probably taking place underlying this disparate pattern of relationships when measurement varies (this can be most clearly seen in Study 5).

Study 1 indicated that the current theoretical understanding and measurement of these constructs are deficient especially regarding the common lack of: conceptualization clarity; diversity and quality of the measurement procedures adopted; studies about the mental representation of social connectedness and loneliness; comparative evidence about unidimensional and multidimensional approaches; lack of evidence to support many assumptions, such as the assumption of conscious access to the constructs and the bipolarity between social connectedness and loneliness; and finally whether the need to belong means a need to feel connected or to avoid loneliness. In the present dissertation, it was not possible to investigate all these issues exhaustively as there are many possible studies to be conducted to establish reliable conclusions regarding each separate issue. However, the studies conducted were an essential first step in the direction of better exploring the relationship between these variables.

Taken together, these studies offer important theoretical, practical, and instrumental contributions to the field of social psychology. The connectedness and loneliness model (CLM) is the main theoretical contribution of the present dissertation as it is the first formal model that we are aware of that describes explicitly a nomological net with antecedent and consequent processes that aims to explain the diversity of effects of connectedness and loneliness on health and social receptivity/avoidance. Study 2 was important to explore this model as it provided the first measure of social connectedness that could be used in all the following studies described here. Study 3 was the first estimation of relationship between connectedness and loneliness, the two main constructs of interest for the CLM. This study allowed the exploration of the bipolarity hypothesis, a long-held assumption in the field of social psychology that the CLM denotes as imprecise and oversimplified. The bipolarity

hypothesis is the hypothesis that social connectedness is the conceptual opposite of loneliness. It was argued that the literature on these subjects frequently assume its truthfulness without the corresponding empirical basis for it (Bekhet et al., 2008; Cacioppo & Hawkley, 2009a; Cacioppo & Patrick, 2011; Epley et al., 2008; Hawkley & Cacioppo, 2010). The CLM was used to investigate the bipolarity hypothesis and the present studies reported here are coherent with the conclusion that its consensus is still premature too as other debates about opposition of concepts (Rafaeli & Revelle, 2006). The bipolarity hypothesis is dangerous to the literature as it stimulates researchers to engage in questionable practices such as using a measure of loneliness to measure social connectedness and vice-versa while there is evidence against the validity of such practices. It is also important to point out that our studies do not prove that the bipolarity hypothesis is wrong. The evidence presented here corroborates our reasoning that there are probably measurement biases involved in the UCLA structure, but we think that other studies are necessary to further explore the bipolarity hypothesis because the measure of loneliness that we adopted – the UCLA – may not be the most informative precisely due to its potential biases.

Studies 4, 5, and 6 allowed the predictive comparison between different measurement procedures with different theoretical assumptions about the mental representation, dimensionality, conceptualization, and level of conscious access of the constructs. These issues were described in Study 1 as some of the main unsolved issues in this literature and the initial evidence gathered in the form of these studies allowed us to start their exploration. The results from such studies were important for the formulation of many details about the CLM. For example, studies 5 and 6 showed evidence that the family dimension is more important than the romantic and social dimensions, corroborating the hierarchy between the sources of connectedness described in the CLM. These studies also illustrated the impact of the measurement procedure used in the study on the conclusions about how loneliness is

associated with variables such as satisfaction with life. The fact that we used a multidimensional measure (SELSA) lead us to very different conclusion compared to those derived from the use of a unidimensional measure (UCLA). One possible way to interpret the magnitude of this difference is that the UCLA may be inflating the associations of loneliness with other constructs because of its contents, but other studies are necessary to more directly test this hypothesis.

Study 4 was especially important to determine the importance of considering the mental representation of connectedness as being metaphorical/spatial. It mainly indicated, as studies 5 and 6 corroborated, that the mental representation of connectedness is probably verbal and declarative. Study 5 allowed us to explore the importance of considering loneliness as a multidimensional construct, a theoretical assumption made in the CLM, and it indicated that the different sources of connectedness included in the instrument present considerably different patterns of relationships with measures of social connectedness, mental health, and satisfaction with life. That is, if one considers how lonely a person is in a specific interpersonal domain or another, the implications of it for the mental health and satisfaction with life can be very different (DiTommaso & Spinner, 1993; Weiss, 1973). The family domain seems to be the most important for most people and we could only have an initial evidence for this hierarchy thanks to studies 5 and 6. Study 6 allowed the exploration of the implicit dimension of loneliness because of the inclusion of the L-IAT and it reinforced the conclusion that connectedness and loneliness are constructs probably better conceptualized as verbally represented in the mind instead of implicitly or non-declaratively represented.

The main instrumental contributions of the present dissertation were the development or adaptation of three different measurement procedures that now can be used by other scientists to further investigate connectedness and loneliness in Brazil: the social connectedness scale (SCS), the pictorial measure of social connectedness (PC), and the social

and emotional loneliness scale (SELSA). These are all short measures of connectedness or loneliness that exhibited acceptable levels of reliability and different sources of evidence favorable to their validity in more than one study reported in the present dissertation.

The CLM can be a fruitful source of ideas for future studies that will further advance our knowledge and applications associated with connectedness and loneliness. One important step for future studies is to evaluate the moderation and mediations predicted by the model which were not the focus of any study reported in the present dissertation. If control over current experience determines the valence of the emotional state and this valence is indeed the mediator predicted by the CLM, then one possible intervention for decreasing loneliness might be to increase the perception of control over current experience. As far as we know, this would be an original and innovative intervention idea in the field of social psychology (S. Cacioppo et al., 2015). Instead of focusing on how to reduce loneliness as the literature usually does, this strategy could change the valence of the emotional state associated with loneliness and consequently protect the person against the potential negative outcomes on health and social avoidance without trying to directly reduce loneliness, which has been an ineffective strategy so far. The exploration of the new theoretical relationships proposed by the CLM might potentially contribute with more innovative practical applications such as this one.

Another important future avenue is the development of new measurement procedures inspired by the CLM. Since our research conclusions are as good as the assumptions of our measures are true, then the development of new measures could allow a better understanding of the importance of connectedness and loneliness as predictors of health-related variables and social receptivity/avoidance. The evidence from studies 4, 5, and 6 supports the appropriateness of the self-report format in comparison to other measurement procedures. Nevertheless, we think that other measurement procedures should still be explored as

alternatives to the self-report format as they may capture other features of connectedness and loneliness that self-report measures cannot capture. We included a small number of alternative measurement procedures in comparison to the self-report measures that we used. This avenue of research still requires further empirical exploration.

One important limitation in all our studies is the fact they were conducted with university students. As other have emphasized (Henrich, Heine, & Norenzayan, 2010), this group of people is hardly representative of the population and this might be especially true when considering the study of loneliness as this experience is more common in older people. We attest this limitation while emphasizing that the present efforts described here are relevant as initial estimates of the relationships that we investigated and they should be complemented by future studies that can collect data with more diversified samples. Another important limitation is the fact that we used fixed orders in the presentation of all the instruments instead of a counterbalanced order. We did it because the process of digitalization of the responses would take much more time and probably results in much more errors if the printed questionnaires had random orders of instruments. This increases the chances that an order effect might have happened and influenced our results although we are unable to evaluate this hypothesis more directly in the present. Finally, our conclusions about the predictive capacities of loneliness and social connectedness measures are limited by the measures of satisfaction with life and mental health that we used (Damásio, Borsa, & Koller, 2014b; Gouveia et al., 2009). Although both have been widely used and presented acceptable psychometric qualities in other studies, they are short measures that capture a simplified conceptualization of the constructs. Future studies should include more sophisticated measures of both constructs to allow a deeper investigation of the effects of loneliness and connectedness on health-related variables and well-being.

Considering our main conclusions in the present dissertation, it is not recommended to use the UCLA as a measure of loneliness. We believe that there are currently superior available alternatives such as the SELSA and that new measures should be developed maybe having the CLM as a theoretical foundation. We hope that the present dissertation will be received as a constructive invitation for improvement to researchers of the field of social psychology. The lack of attention to conceptual clarity in the theories we use and the instruments we develop might greatly bias our theoretical conclusions and practical recommendations regarding important phenomena such as social connectedness and loneliness. More importantly, as scientists we should be motivated to engage in any effort that would help us to more precisely measure and understand the things that we want to measure and understand. We believe that an important effort in this direction is necessary in this area of research.

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Appendices

Appendix 1

Social Connectedness Scale (SCS)

Utilize as opções de resposta abaixo para informar o quanto que cada uma das frases à esquerda são verdadeiras para você e te descrevem bem. A escala vai de "Discordo totalmente" a "Concordo totalmente".

	Discordo totalmente	Discordo	Não sei	Concordo	Concordo totalmente
1. Eu realmente me sinto aceito(a) por outros em minha vida.					
2. Muitas vezes, eu não me sinto vinculado(a) afetivamente com os outros.					
3. Existem várias ocasiões em que estou acompanhado de um grupo de amigos e não me sinto completamente vinculado(a) a eles.					
4. Eu sinto um forte sentimento de vínculo quando estou com os meus amigos.					
5. Existem lugares que vou onde me sinto vinculado afetivamente com os outros.					
6. Eu sinto que existem muitas pessoas com quem eu tenho um vínculo afetivo.					
7. Quando estou com a minha família, sinto que tenho um vínculo afetivo com eles.					

Appendix 2

Positive and Negative Affect Scale (PANAS)

Indique por meio da escala apresentada abaixo em que nível você normalmente sente cada uma das emoções listadas no lado esquerdo.

|	Nem um pouco	Raramente	Ocasionalmente	Frequentemente	Bastante
1. Ativo					
2. Alerta					
3. Atento					
4. Determinado					
5. Entusiasmado					
6. Empolgado					
7. Inspirado					
8. Interessado					
9. Forte					
Com medo					
Envergonhado					
Aflito					
Culpado					
Hostil					
Irritável					
Inquieto					
Nervoso					
Apavorado					

Chateado					

Appendix 3

Overlap of Self, Ingroup, and Outgroup (OSIO)

Por favor, marque um "X" no quadrado ao lado da imagem que melhor descreve a proximidade entre você e seus pais e amigos próximos.
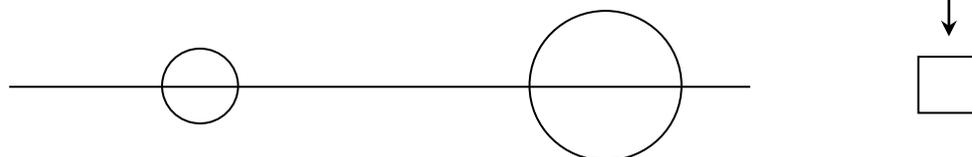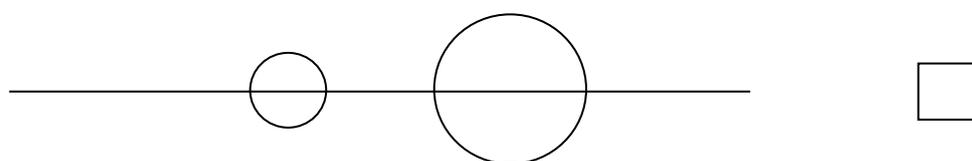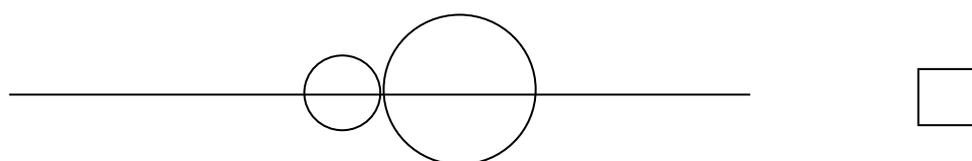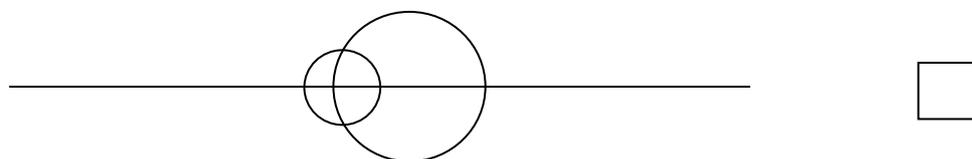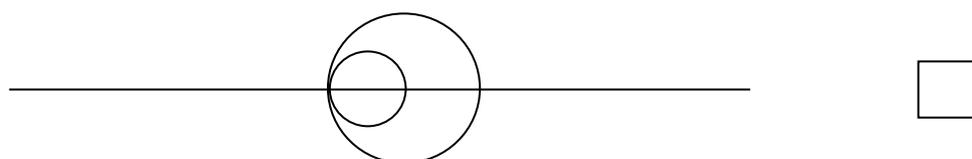
você   pais e amigos próximos

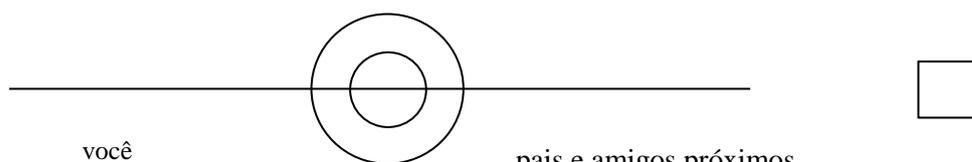você   pais e amigos próximos

você   pais e amigos próximos
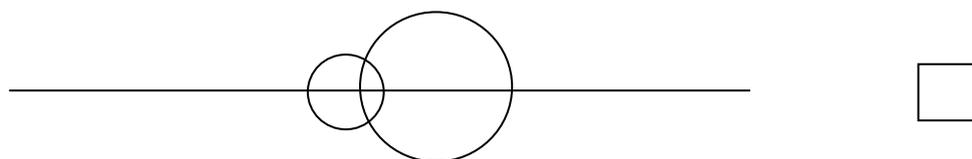
você   pais e amigos próximos

você   pais e amigos próximos
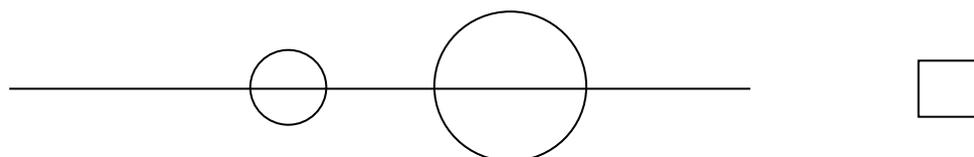
você   pais e amigos próximos

você   pais e amigos próximos

Por favor, marque um "X" no quadrado ao lado da imagem que melhor descreve a proximidade entre você e pessoas desconhecidas.
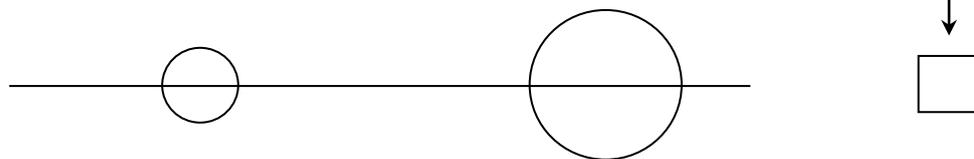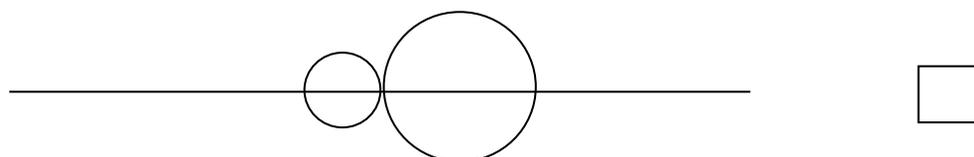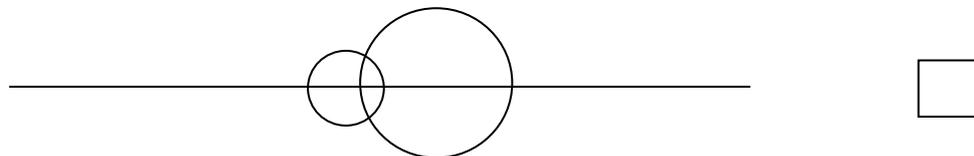
você　　　　　　　　　　　　　　　Pessoas desconhecidas

você　　　　　　　　　　　　　　　Pessoas desconhecidas
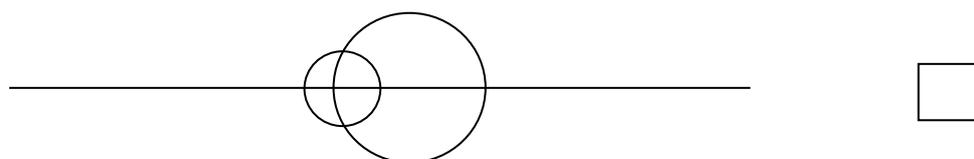
você　　　　　　　　　　　　　　　Pessoas desconhecidas

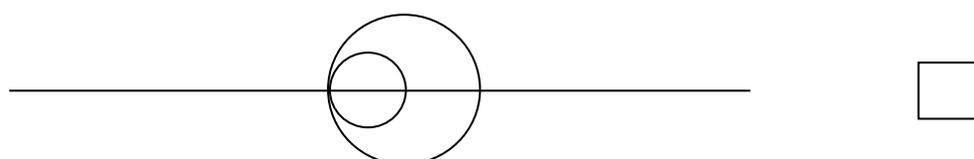você　　　　　　　　　　　　　　　Pessoas desconhecidas

você　　　　　　　　　　　　　　　Pessoas desconhecidas

você　　　　　　　　　　　　　　　Pessoas desconhecidas
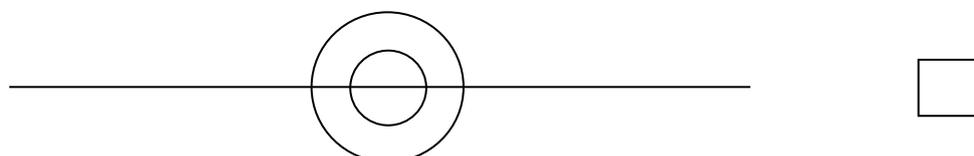
você　　　　　　　　　　　　　　　Pessoas desconhecidas

Appendix 4

UCLA Loneliness Scale (UCLA)

As informações a seguir descrevem como as pessoas às vezes se sentem. Para cada afirmação, por favor, indique a frequência com que você se sente da maneira descrita, marcando a opção mais adequada. Aqui está um exemplo:

"Com que frequência você se sente feliz?"

Se você nunca se sentiu feliz, você responderia "nunca"; se você sempre se sente feliz, você responderia "sempre".

	Nunca	Raramente	Às vezes	Sempre
1. Com que frequência você sente que está "em sintonia" com as pessoas ao seu redor?				
2. Com que frequência você sente que lhe falta companhia?				
3. Com que frequência você sente que não há ninguém a quem possa recorrer?				
4. Com que frequência você se sente só?				
5. Com que frequência você se sente parte de um grupo de amigos?				
6. Com que frequência você sente que tem muito em comum com as pessoas ao seu redor?				
7. Com que frequência você sente que já não é próximo de alguém?				
8. Com que frequência você sente que seus interesses e ideias não são compartilhados por aqueles que estão ao seu redor?				
9. Com que frequência você se sente extrovertido e amigável?				
10. Com que frequência você se sente próximo das pessoas?				
11. Com que frequência você se sente deixado de fora?				
12. Com que frequência você sente que suas relações com os outros não são significativas?				
13. Com que frequência você sente que ninguém realmente lhe conhece bem?				
14. Com que frequência você se sente isolado dos outros?				
15. Com que frequência você sente que pode encontrar companhia quando quiser?				
16. Com que frequência você sente que há pessoas que realmente lhe entendem?				
17. Com que frequência você se sente tímido (a)?				
18. Com que frequência você sente que as pessoas estão ao seu redor, mas não com você?				

19. Com que frequência você sente que há pessoas com quem pode conversar?				
20. Com que frequência você sente que há pessoas a quem pode recorrer?				

Appendix 5

Need to Belong Scale (SCS)

Indique o quanto as seguintes sentenças são verdadeiras para você ou te caracterizam bem utilizando a escala que vai desde "nem um pouco" até "extremamente":

	Nem um pouco	Levemente	Moderadamente	Muito	Extremamente
1. Se outras pessoas não parecem me aceitar, eu não deixo que isso me aborreça.					
2. Eu me esforço para não fazer coisas que vão fazer outras pessoas me evitarem ou me rejeitar.					
3. Eu raramente me preocupo se outras pessoas se importam comigo.					
4. Eu preciso sentir que existem pessoas com quem eu posso contar em momentos de necessidade.					
5. Eu quero que outras pessoas me aceitem.					
6. Eu não gosto de ficar sozinho.					
7. Ficar distante dos meus amigos por longos períodos de tempo não me incomoda.					
8. Eu tenho uma forte necessidade de pertencimento a outras pessoas.					
9. Incomoda-me muito quando eu não sou					

incluído nos planos das outras pessoas.					
10. Meus sentimentos são facilmente feridos quando eu sinto que outras pessoas não me aceitam.					

Appendix 6

Satisfaction with Life Scale (SWL) and Mental Health Index (MH)

Abaixo, você encontrará cinco afirmações com as quais pode ou não concordar.
Usando a escala de resposta a seguir, que vai de 1 a 7, indique o quanto concorda ou discorda
com cada uma; **escreva um número no espaço ao lado da afirmação**, segundo sua opinião.
Por favor, seja o mais sincero possível nas suas respostas.

	Opções de reposta:
_____ Na maioria dos aspectos, minha vida é próxima ao meu ideal.	
_____ As condições da minha vida são excelentes.	7 = Concordo totalmente 6 = Concordo
_____ Estou satisfeito com minha vida.	5 = Concordo ligeiramente 4 = Nem concordo nem discordo
_____ Dentro do possível, tenho conseguido as coisas importantes que quero da vida.	3 = Discordo ligeiramente 2 = Discordo
_____ Se pudesse viver uma segunda vez, não mudaria quase nada na minha vida.	1 = Discordo totalmente

Estas questões são sobre como você se sente e como tudo tem acontecido com você durante as
últimas 4 semanas. Para cada questão, por favor, **marque um "X"** em uma das opções de
resposta que mais se aproxime da maneira como você se sente. Leia as opções de resposta a
seguir.

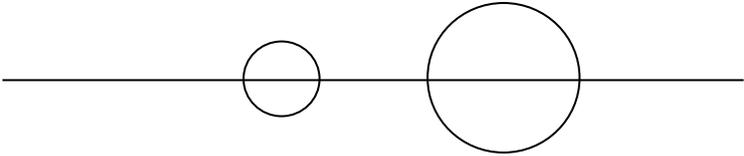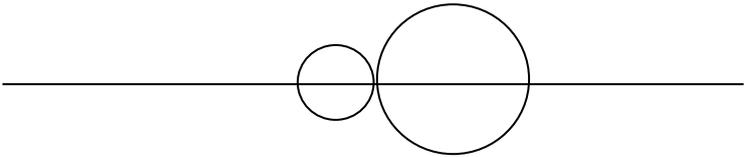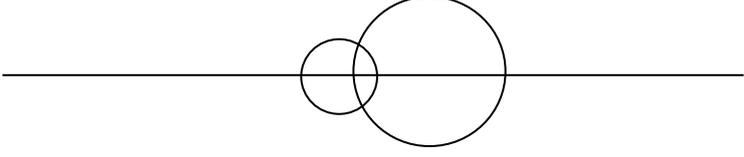| 1	2	3	4	5
Nunca	Uma pequena parte do tempo	Alguma parte do tempo	A maior parte do tempo	Todo o tempo

Em relação às últimas quatro semanas:
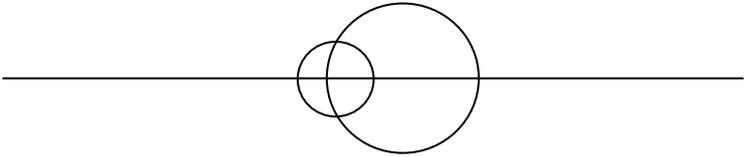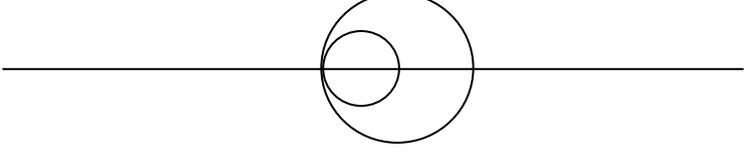
Quanto tempo você tem se sentido uma pessoa muito nervosa?	1	2	3	4	5
Quanto tempo você tem se sentido tão deprimido(a) que nada possa animá-lo(a)?	1	2	3	4	5
Quanto tempo você tem se sentido calmo(a) ou tranquilo(a)?	1	2	3	4	5
Quanto tempo você tem se sentido desanimado(a) e abatido(a)?	1	2	3	4	5

Quanto tempo você tem se sentido uma pessoa feliz?	1	2	3	4	5

Quanto tempo você tem se sentido uma pessoa feliz?	1	2	3	4	5

Appendix 7

Pictorial measure of Social Connectedness (PC)

Por favor, marque um "X" no quadrado ao lado da imagem que melhor descreve a proximidade entre você e as pessoas de modo geral.

Appendix 8

Perception of Social Support Scale (PSSS)

Marque uma das opções ao lado de cada item (as opções variam de "1 = Nunca" a "4 = Sempre") que melhor te descreva de acordo com a frase a seguir.

1	2	3	4
Nunca	Poucas vezes	Muitas vezes	Sempre

Com que frequência eu percebo que posso contar com o apoio de alguém que:

	1	2	3	4
Dá sugestões sobre viagens que quero fazer.	1	2	3	4
Empresta-me algo de que preciso.	1	2	3	4
Dá sugestões sobre oportunidades de emprego para mim.	1	2	3	4
Dá sugestões sobre profissionais para ajudar-me.	1	2	3	4
Dá sugestões sobre algo que quero comprar.	1	2	3	4
Ajuda-me na execução de tarefas.	1	2	3	4
Empresta-me dinheiro.	1	2	3	4
Dá sugestões sobre meu futuro.	1	2	3	4
Orienta minhas decisões.	1	2	3	4
Sugere fontes para eu me atualizar.	1	2	3	4
Substitui-me em tarefas que não posso realizar no momento.	1	2	3	4
Dá sugestões sobre lugares para eu me divertir.	1	2	3	4
Toma conta de minha casa em minha ausência.	1	2	3	4
Fornece-me alimentação quando preciso.	1	2	3	4
Leva-me a algum lugar aonde eu preciso ir.	1	2	3	4

Ajuda-me com minha medicação se estou doente.	1	2	3	4

1	2	3	4
Nunca	Poucas vezes	Muitas vezes	Sempre

Com que frequência eu percebo que posso contar com o apoio de alguém que:

Esclarece minhas dúvidas.	**1**	**2**	**3**	**4**
Ajuda-me a resolver um problema prático.	1	2	3	4
Dá sugestões sobre cuidados com a minha saúde.	1	2	3	4
Consola-me se estou triste.	1	2	3	4
Dá atenção às minhas crises emocionais.	1	2	3	4
Ouve com atenção meus problemas pessoais.	1	2	3	4
Compreende minhas dificuldades.	1	2	3	4
Está ao meu lado em qualquer situação.	1	2	3	4
Comemora comigo minhas alegrias e realizações.	1	2	3	4
Faz-me sentir valorizado como pessoa.	1	2	3	4
Preocupa-se comigo.	1	2	3	4
Conversa comigo sobre meus relacionamentos afetivos.	1	2	3	4
Demonstra carinho por mim.	1	2	3	4

Appendix 9

Social and Emotional Loneliness Scale (SELSA)

Indique o quanto as seguintes sentenças são verdadeiras para você ou te caracterizam bem utilizando a escala que vai de "Discordo totalmente" até "Concordo totalmente".

1	2	3	4	5
Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente

	1	2	3	4	5
Eu sou muito ligado afetivamente à minha família.	1	2	3	4	5
Eu me sinto parte da minha família.	1	2	3	4	5
Minha família se importa muito comigo.	1	2	3	4	5
Minha família é importante para mim.	1	2	3	4	5
Eu me sinto próximo da minha família.	1	2	3	4	5
Eu tenho um(a) parceiro(a) romântico(a) com quem compartilho meus pensamentos e sentimentos mais íntimos.	1	2	3	4	5
Eu tenho um(a) parceiro(a) romântico(a) ou conjugal que me dá o apoio e incentivo que preciso.	1	2	3	4	5
Eu tenho uma necessidade não suprida de um relacionamento romântico e íntimo.	1	2	3	4	5
Eu estou apaixonado(a) por alguém que também está apaixonado(a) por mim.	1	2	3	4	5
Eu tenho alguém que supre as minhas necessidades de intimidade romântica.	1	2	3	4	5
Eu tenho um parceiro romântico e contribuo para sua felicidade.	1	2	3	4	5
Eu tenho amigos(as) a quem posso recorrer para pedir informações.	1	2	3	4	5
Eu posso contar com a ajuda dos(as) meus/minhas amigos(as).	1	2	3	4	5
Eu tenho amigos(as) com quem eu posso conversar sobre as pressões da minha	1	2	3	4	5

vida.					
Eu tenho um amigo(a) ou amigos(as) com quem posso compartilhar minhas opiniões.	1	2	3	4	5