CASE FORMULATION USING FUZZY COGNITIVE MAPS: CONCEPTUAL AND METHODOLOGICAL BASIS AND CASE STUDY

FORMULACIÓN DE CASO MEDIANTE MAPAS COGNITIVOS BORROSOS: BASES CONCEPTUALES Y METODOLÓGICAS Y EJEMPLO DE CASO

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Abstract

This study demonstrates the use of Fuzzy Cognitive Maps for case formulation and as a tool for facilitating the process of change in psychotherapy. The case of a 55-year-old man (Henry) who experiences difficulties in social-affective relationships, avoids all kinds of conflict and whose rigidity in the family environment causes outbursts of anger, is presented from a constructivist standpoint. A single case design was used, following the case conceptualisation format proposed by the Fuzzy Cognitive Map of Human Problems Formation and Resolution method. From a methodological perspective, the Grid Technique, the Implications Grid and the GridFCM software were used to compile the Fuzzy Cognitive Map. The results reveal that including Fuzzy Cognitive Maps in case formulation enables the patient to play a more active role in the process of change. It also creates simulated scenarios that offer a dynamic and causal image of the patient's System of Personal Meanings, provides feedback on the pattern of both synchronous and diachronic change and facilitates the monitoring of the dynamics of change.

Keywords: *practice-oriented research, case formulation, fuzzy cognitive map, fuzzy logic, grid technique, implication grid, psychotherapeutic process, constructivism*

Resumen

El presente estudio muestra la utilización de Mapas Cognitivos Borrosos para la formulación de caso y como herramienta facilitadora del proceso de cambio en psicoterapia. Desde la línea constructivista se aborda el caso de un hombre de 55 años (Henry) que muestra dificultades en las relaciones socio-afectivas, evita todo tipo de conflicto y su rigidez en la convivencia familiar le provoca estallidos de ira. Se utilizó un diseño de caso único siguiendo el formato de conceptualización de caso según el Mapa Cognitivo Borroso de Formación y Resolución de Problemas Humanos. En la base metodológica se utiliza la Técnica de Rejilla, la Rejilla de Implicaciones y el software GridFCM como procedimiento de obtención del Mapa Cognitivo Borroso. Los resultados muestran que incluir Mapas Cognitivos Borrosos en la formulación de casos facilita al paciente tener un rol más activo hacia el proceso de cambio, crear escenarios de simulación ofreciendo una imagen dinámica y causal de su Sistema de Significados Personales, aporta una retroalimentación del patrón del cambio tanto sincrónica como diacrónica y facilita la monitorización de las dinámicas de cambio.

Palabras clave: *investigación orientada a la práctica, formulación de caso, mapa cognitivo borroso, lógica borrosa, técnica de rejilla, rejillas de implicaciones, proceso psicoterapéutico, constructivismo*

A medical-biological conception of psychotherapy prompts practitioners to start the process by coming up with a *diagnosis* (this is consistent with the medical model; for a summary, see Botella, 2020). As an alternative, a consistently psychological conception prompts practitioners to establish a *conceptualisation model* or *case formulation*. Kelly (1955, see Botella & Feixas, 1998), for example, remarked on this almost 70 years ago, when he insisted that what was truly important in a therapist's work was to arrive at a *transitive assessment* that would suggest how best the patient could be helped to overcome their problem, rather than making a diagnosis that only tells us what is, in many cases, self-evident: the name of the problem from which the patient is suffering. Problems associated with use of psychopathological taxonomies in psychotherapy go beyond the focus of this paper and have been described for decades in a growing body of literature that has pointed out all kinds of difficulties that range from ethical to practical in nature (see, for example, Frances, 2013; Neimeyer & Raskin, 2000).

In the field of conceptualisation models, several sound proposals have been made recently from a number of different approaches. All are based on the shared aim of enabling a complex, profound understanding of the problem prompting the client to seek help, while at the same time enabling the therapist to identify possible intervention avenues.

The model presented here is a *constructivist, collaborative, client-focused, integrative and transdiagnosic* proposal, characterised by a high degree of *theoretical coherence, technical eclecticism, methodological sophistication and technological support* (see Saúl et al., 2022 for a more detailed description of the last two points in particular).

In relation to constructivism, this case conceptualisation model is firmly based on paying close attention to the client's meaning map, without forcing it to fit in with any preconceived theoretical framework. Rather, the client's attention is directed towards compiling said map, an exercise that encourages them to model, as precisely as possible, their own system of constructs (as well as the relationships and dynamics that exist between them, a novelty in comparison with previous methods) relating to themselves, their partner and/or their family.

In terms of the proposal being collaborative and client-focused, the method is effectively placed at the service of the client's narrative, with therapist and patient working together to establish a consensus-based model.

The proposal is integrative in the sense that it includes concepts from different theories, all of which are placed at the service of a constructivist metatheory that then enables practitioners to select therapeutic aims and strategies that are consistent in terms of theory and eclectic in terms of technique (the traditional approach adopted by constructivism in psychotherapy, see Botella, 2021).

In relation to methodological sophistication and technological support (see Saúl et al., 2022), the model is based on a series of procedures with a sound mathematical basis rooted in Fuzzy Logic, which have been integrated into a specific

software program that develops and implements them (Sanfeliciano & Saúl, 2022).

The case conceptualisation model presented here (see Botella, 2007, 2021, Saúl et al., 2022) is articulated as a Fuzzy Cognitive Map (described in more detail below, as well as in Botella, 2021 and Saúl et al., 2022) and comprises the following factors:

i. Problem. In the field of psychotherapy, a problem is a critical situation that prompts the demand for treatment and that, in general, is distressing for the patient and/or those around them. Problems prompting the demand for psychotherapy vary widely from case to case, ranging from physical symptoms and disorders to relational and existential issues, as well as all kinds of common psychopathologies.

ii. Predisposing factors. These are biographical, developmental and relational variables or processes that increase the likelihood of someone having a problem.

iii. Triggers. The factors that trigger a problem are, in general, traumatic or critical events that activate processes of invalidation. Due to the heterogeneity of human problems, triggers can vary widely - even more than problems themselves, since humans tend to react with similar symptoms to different trigger factors.

iv. Maintenance factors. Maintenance factors are those that, once a problem has been triggered, contribute to making it more difficult to resolve than to perpetuate. The following are some of the most widely researched maintenance factors (see Botella, 2007): (1) position in relation to change: pre-contemplative or contemplative stage (Prochaska, 1999), or in other words, denial of the problem or lack of commitment to resolving it; (2) beliefs, constructs, narratives and incapacitating internal models; (3) egosyntonic problems, i.e., problems that, paradoxically, contribute to bestowing greater coherence on personal identity; and (4) the relational coherence of the position in which the problem places the client.

v. Reconstruction process. Due to the natural human capacity to resist and cope with adversity, the reconstruction process consists of self-correcting movements towards resolving and overcoming the problem that are activated in response to the manifestation of that problem. It is basically a process oriented towards achieving goals and targets using a variety of strategies (e.g., coping, overcoming, reconstructing and adapting, etc.).

vi. Resources and competencies. The reconstruction process has a powerful ally in this field, namely all the capacities that the patient has gained as a result of their life experiences, personality and personal development, which can help counteract the invalidating effect of the problem. The following are some of the most widely researched maintenance factors (see Botella, 2007): (1) exceptions to the problem; (2) competencies (skills); (3) beliefs, constructs and competent internal models; (4) support network; (5) secure attachment styles; (6) healthy family relations; and (7) resources in other areas, for example, the individual's professional, academic or social context.

vii. Motivation. This can also be a powerful ally in the reconstruction process, and its most widely-studied manifestations include: (1) position in relation

to change: preparation, action or maintenance stage (to use the terms coined by Prochaska, 1999); (2) self-efficacy expectations; (3) previous positive therapeutic experiences; (4) clear and well-defined goals; and (5) self-assessed motivation.

viii. Difficulties. These are factors that block the reconstruction process through different pathways of inhibitory action. The following are some of the difficulties most commonly referred to in the literature (see Botella, 2007, 2021): (1) extreme gravity; (2) low or no motivation; (3) serious relational difficulties; (4) poor or no psychological mindset; and (5) nonspecific problem.

Compiling a Fuzzy Cognitive Map is a procedure for modelling complex situations from the real world (Kosko, 1986). Fuzzy Cognitive Maps (FCMs) can be based on qualitative and quantitative 'data' and are often used to represent different mental models of how the world works, as a means of drawing conclusions regarding the belief and value systems of different individuals and groups. They provide a common language and means of representation to enable different stakeholders to make sense of complex situations that involve multiple perspectives and values.

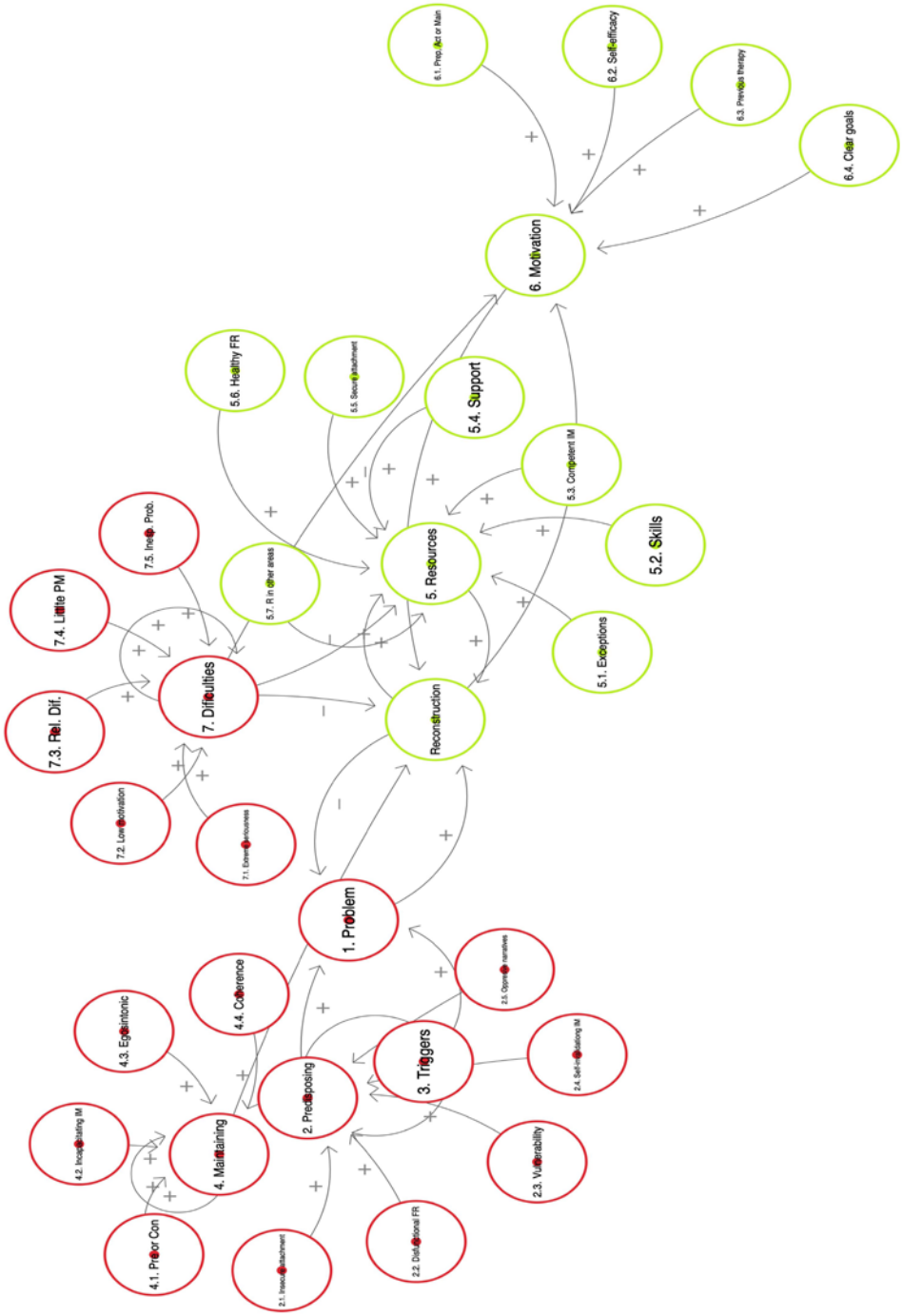
The resulting FCM is a visual representation of how a system works, from the perspective of the people constructing it. A FCM takes the form of a graph in which the nodes represent concepts and edges represent perceived causal relationships between them. The concepts are 'variables' that may or may not be caused by others. Kosko (1986) used the example of a model representing social instability, which may (or may not) cause other 'things'. Variable concepts can be measurable quantities such as temperature or population, or abstract concepts (more difficult to quantify directly) such as trust or political will.

Figure 1 shows the FCM that articulates the case conceptualisation presented here (the components of which are described above), after the causal relations between nodes have been added in the form of edges.

The FCM shown in Figure 1 was compiled in the third person, or in other words, from a perspective outside the client's system of constructs. This is what Kelly (1955) called a professional construct system, referring to a map that makes sense of the client's own map, subsuming it without distorting it.

Throughout the course of this paper, we will try to show how both maps (this one and the client's own one) are articulated together.

Figure 1
Fuzzy Cognitive Map of the Case Conceptualisation



Methodological basis

Compiling a FCM using the patient's Personal Meaning System

The method for compiling a FCM using the patient's Personal Meaning System (PMS) has been described by both Botella (2021) and (in more detail) Saúl et al. (2022). It is based on mathematical models rooted in algebra, calculus and graph theory. The aim is to transform the subjective information provided by the patient into operationalised data that can be used to model their individual reality and express it through cognitive indexes (centrality, AUC, stability, etc.), graphic representations (self-digraph, PCSD, etc.) and mathematical simulations (scenario inference). The methodology is explained in more detail below, although for a deeper exploration, we refer the reader to Botella (2021) and Saúl et al. (2022).

This procedure uses the Repertory Grid Technique (Kelly, 1955) and the Implication Grid (Hinkle, 1965) to obtain the data required to compile the FCM. These data are: (a) the personal constructs that make up the patient's PMS (nodes); (b) their assessment of their Self-Now and Ideal-Self in accordance with these constructs (weights); and (c) the cause-effect relationships between the different constructs (edges). Once analysed, this information will reveal the structural aspects of the system and enable us to simulate the dynamics associated with it. To enable the reader to gain a better understanding of how this information is obtained, we will now briefly describe the Repertory Grid Technique (RGT) and Implication Grid (ImpGrid) protocols.

The RGT is a semi-structured interview used to collect information about the patient's PMS and how said system influences the way they construct both themselves and their most immediate environment. This tool is very flexible and can easily be adapted to most needs, and although for research reasons and to ensure inter-subject consistency, in our research group we used a question-based protocol (see Figure 2), for a clinical assessment of a patient, we recommend you use a more open approach than that described here.

Figure 2
List of Questions Proposed for Generating Personal Constructs

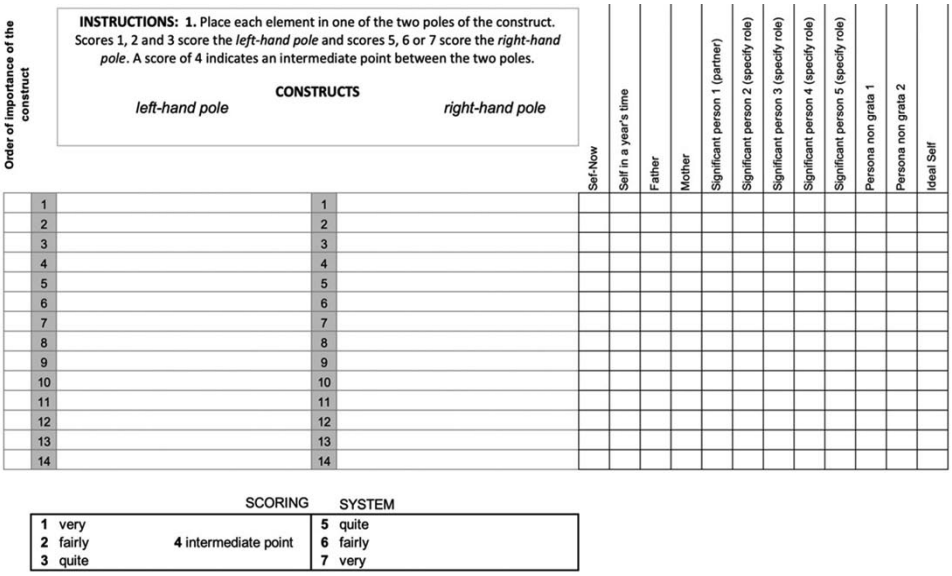
Comparison Self-Father
Construct 1. In what ways is your Self-Now like your Father?
Construct 2. In what ways is it different?
Comparison Self-Mother
Construct 3. In what ways is your Self-Now like your Mother?
Construct 4. In what way is it different?
Comparison Father-Mother
Construct 5. In what ways are your Mother and Father alike?
Construct 6. In what ways are they different?
Comparison Self-Now-Significant Other 1
Construct 7. In what ways is your Self-Now like your Significant Other 1 (Intimate Partner)? If you do not have a partner, your Significant Other 1 will be the most significant person in your life right now, other than your father or your mother. Please indicate their role.
Construct 8. In what ways is your Self-Now different from your Significant Other 1?
Comparison Self-Now-Significant Other 2
Construct 9. In what ways is your Self-Now like your Significant Other 2?
Comparison Self-Now-Significant Other 3
Construct 10. In what ways is your Self-Now different from your Significant Other 3?
Comparison Self-Now-Significant Other 4
Construct 11. In what ways is your Self-Now like your Significant Other 4?
Comparison Self-Now-Significant Other 5
Construct 12. In what ways is your Self-Now like your Significant Other 5?
Comparison Self-Now-Persona Non Grata 1
Construct 13. In what ways is your Self-Now different from your Persona Non Grata 1?
Comparison Self-Now-Persona Non Grata 2
Construct 14. In what ways is your Self-Now different from your Persona Non Grata 2?

1.- The RGT protocol is divided into 3 different stageGeneration of elements. The patient must provide a list of significant people who form part of their immediate environment (father, mother, siblings, intimate partner, etc.). We also recommend that they add someone they consider to be a *persona non grata* to the list, as well as an element that represents themselves (*Now-Self*) and an element that represents their desires (*Ideal-Self*). Figure 3 shows the elements proposed by our research group.

2.- Generation of constructs: Personal constructs are generated by comparing the previous elements. Each construct is defined by two poles, the emerging pole and its opposite. An example of the question protocol is provided in Figure 3.

3.- Completing the scoring matrix (Figure 3): Finally, the patient is asked to score the different aspects in accordance with an established scale. For each construct, they must indicate which pole defines each element and to what degree. The proposed scale ranges from 1 to 7, with 1 to 3 leaning towards the left-hand pole of the construct, and 5 to 7 leaning towards the right-hand pole. A score of 4 indicates a lack of definition.

Figure 3
Template of the Proposed Repertory Grid Technique



The Implication Grid is a semi-structured interview that explores attributions of causality between the constructs making up the patient's PMS. We used a slightly modified version of the original interview developed by Hinkle (1965). Figure 4 shows the grid template.

Once all the patient's constructs have been listed using the RGT, the ImpGrid protocol used is as follows:

1.- We select the first construct in the patient's PMS.

2.- We conduct the interview in order to determine the implications of the construct. The instructions given are as follows:

> Consider this construct (left-hand pole - right-hand pole) for a moment. Now, if you were to change back and forth from one side to the other—that is, if you woke up one morning and realised that you were best described by (pole opposite to the self), while the day before you had been best described by (pole associated with the self)—if you realised that you had changed in this one respect—what other constructs of those remaining would be 1ikely to be changed by a change in yourself in this one construct alone? Remember, a change in just this one construct is the cause, while the changes in these other constructs are the effects implied by the change from (pole associated with the self) to (pole opposite to the self). What I'd like to find out, then, is in which of these constructs do you expect a change to occur as the result of knowing that you have changed from (pole associated

with the self) to (pole opposite to the self). (Hinkle, 1965, pp.37-38, cited in Fransella, 2004)

3.- For each construct named by the patient, we ask two questions and note down the associated score on the template (Figure 4) in accordance with the answer: (a) Towards which pole would the change take place; and (b) How intense would that change be? To add further nuance, we use scores between -3 and -1 to indicate the left-hand pole and scores between 1 and 3 to indicate the right-hand pole. A score of 0 indicates no change.

4.- We repeat steps 2 and 3 for each of the constructs in the patient's PMS.

To operationalise all these data, we use an open source software program called GridFCM (Sanfeliciano & Saúl, 2022), an R package (R Core Team, 2022) developed by the Constructivist Research Group working at the Spanish National Distance Education University - UNED (https://blogs.uned.es/gicuned/). It should be noted that this package is supported by other R packages such as OpenRepGrid, Igraph and Plotly (Csardi & Nepusz, 2006; Heckmann, 2016; Sievert, 2020). This software enables us to both compile FCMs and carry out more classical personal construct psychology analyses (implicative dilemmas, principal components analyses, cluster analyses, etc.; see, for example, Feixas et al., 2009). For a better understanding of the data flow within the software, please see Figure 5.

Figure 4
Impgrid Template

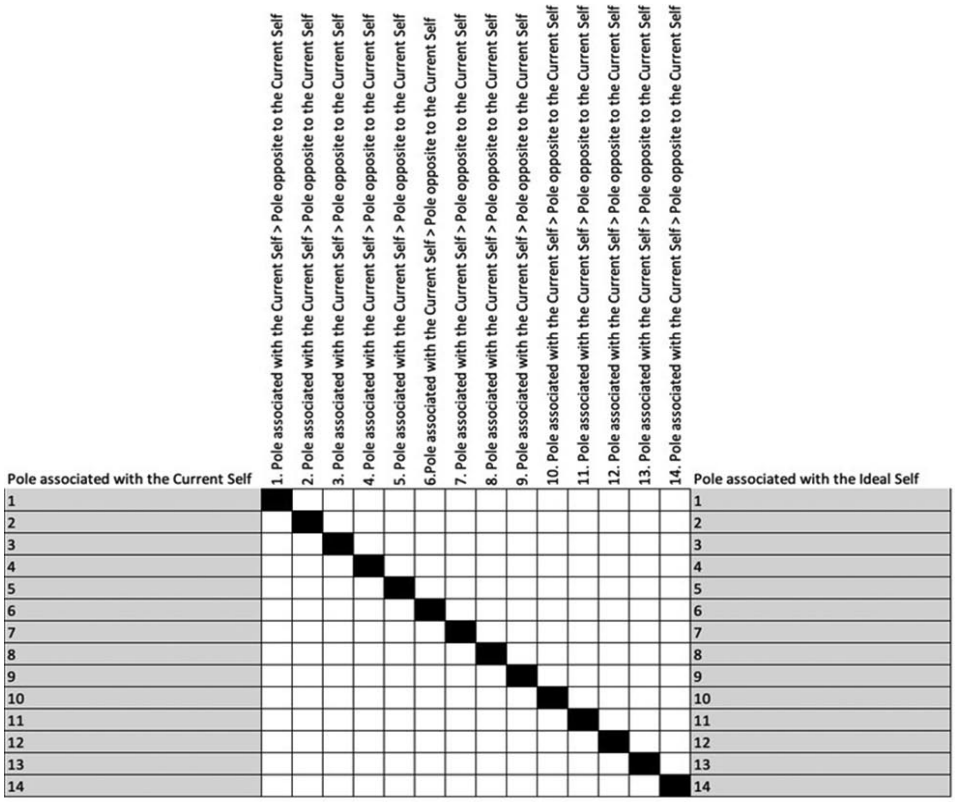
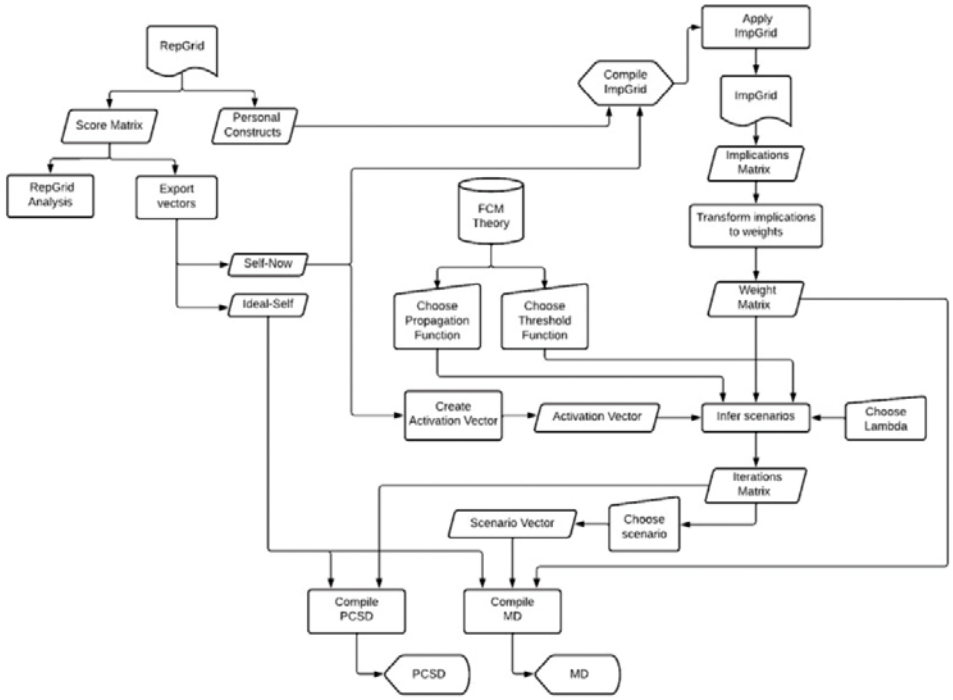


Figure 5
Compiling a FCM and PCSD using the Repertory Grid Technique



Note: FCM (Fuzzy Cognitive Map), PCSD (Personal Construct System Dynamic), MD (Map Digraph).

Indexes and Graphs derived from GridFCM

The GridFCM tool (Sanfeliciano & Saúl, 2022) creates a mathematical model representing the patient's cognitive reality, thereby enabling multiple analyses to explore its structure and dynamics. Of these, we will explain those which are most relevant due to their interest and application in the case study: (a) the FCM digraph, (b) the PCSD graph and (c) the AUC index.

First, the FCM digraph shows the structure of the patient's PMS and can be used to visually explore both the adaptation of the Self-Now to the Ideal-Self and the implications between constructs. It is portrayed in the form of a directed graph in which the nodes represent the patient's personal meanings and the edges the implications or attributions of causality between meanings (see the case digraph in Figure 9).

Second, the Personal Construct System Dynamic (PCSD) graph is a simulation of the possible development of the Self-Now, based on the implications between constructs. It is portrayed through a line graph in which the Y axis represents the distance to the Ideal-Self and the X axis represents the time evolution in terms of

mathematical iterations (see the case PCSD graph in Figure 8).

Finally, the Area Under the Curve (AUC) index is a value derived from the PCSD graph that indicates, in quantitative terms, the fit of the simulation of the patient's ideal scenario to each of the constructs. In other words, it tells us the extent to which the patient expects a good or bad development of their personal meanings over time. This index can be any value between [0,1], with 0 indicating a perfect fit to the Ideal-Self and 1 the maximum distance to the Ideal-Self (see the case AUC indexes in Figure 8).

These three analyses are explained in more detail and exemplified in the case study analysed below. However, if the reader is interested in exploring GridFCM and its code, we refer them to our official Github repository (https://github.com/GICUNED/GridFCM).

Clinical case

We will now present a clinical case that aims to exemplify how a patient's clinical history should be taken and how one can use FCMs to formulate a case. In the interest of brevity, we will not present all the information derived from the data analysed with the GridFCM program (Sanfeliciano & Saúl, 2022). The free program Loopy will be used to exemplify the change dynamics in the maps (Case, 2022).

Henry is a 55-year-old male who has been married for 26 years and works as a member of the Spanish Civil Guard. He lives with his wife and daughter and he likes to have a routine based on strict rules. This causes arguments with his adolescent daughter and he also feels that his relationship with his wife is passing through a difficult moment. In relation to his family of origin, he has one sister who is five years his junior and with whom he shares certain interests, such as sport, and even though his parents live in another city, he visits them fairly frequently. Henry agreed to psychological treatment by signing a written informed consent form and his case was explored using the Transitive Hypothesis (Asay & Lambert, 1999; Botella & Feixas, 1998; Fernández Liria & Rodríguez Vega, 2001) and the Case Conceptualisation Format based on the FCM-FRP concept (Botella, 2020). This last concept helps condense the information recorded into a single report, unifying both the quantitative and the qualitative data collected. Moreover, it helps the therapist find their bearings in the patient's map and structure in a more systematic manner.

History of the Problem

Henry has an insecure attachment style and does not usually express his feelings and needs, preferring to deny that he even has them. Due to his fear of rejection, he avoids conflict of any kind, acting submissively and striving always to be perfect in other people's eyes as a tactic to gain the affection and approval he requires. His belief model prompts him to believe that doing this will cause others to value him more highly. Specifically, Henry demonstrates anxious-ambivalent attachment in which he hides behind a fearful demeanour. He sees himself as weaker than other

people and believes that his words and feelings have no place in his relationships.

His request for help was prompted by outbursts of anger both at home and at work. He has a low sense of his own capacity and low self-esteem, manifested in an anxious-depressive state. *'I have to learn to get angry and not be so scared of how others will react.'* His principal therapeutic goal is to learn to make decisions and to feel calmer.

Henry's current situation has become a problem due to the predisposing factors, triggers and maintenance factors outlined below.

Predisposing factors

Henry has an insecure attachment style (anxious-ambivalent with his mother and avoidant with his father), and the style that is most predominant in his intimate relationships is anxious-ambivalent. Moreover, relations in his family of origin seem to be dysfunctional due to the lack of validation he experienced in the construction of his identity and the guilt generated by his witnessing frequent arguments between his parents.

In his Repertory Grid (RG) (see Figure 6) we see alliance or coalition constructs that align with his father being *Perfectionist*, *Protective*, *Tolerant* and *Phony*. However, the only construct he shares with his mother is *Well mannered*. This indicates an absence of emotional constructs and the predominance of a normative environment.

Henry also considers *Generous* and *Hard-working* to be family identity constructs, although he believes that his family of origin is *Emotionally weak* and *Fearful*. These models of his family of origin make it hard for Henry to be more flexible, ask for what he needs and feel that he has value for others.

In relation to his mother, there are several constructs in which the self is undefined; for example, he does not know whether he is *Organised-Chaotic*, *Persevering-Irresolute*, or *Creative-Insensitive*. The existence of depressive episodes linked to his mother may explain his lack of definition in these constructs. Moreover, his generational limit constructs locate his parental figures at the family-minded pole, although Henry has a cognitive conflict in that he does not currently know whether he is more *Family-minded* or *Individualist*. This dilemma may stem from the ambivalence he feels in his social relationships since, on the one hand, he is scared of losing them, but on the other, his need to please invalidates him.

For this reason, Henry presents with a very intense self-invalidating internal model. He considers himself to be fairly *Emotionally weak*, very *Fearful* and fairly *Phony*. Moreover, he sees himself as incapable of remaining firm in one of his decisions if it goes against the wishes of another, deceiving himself as a means of avoiding conflict. '*If I'm perfect, no one will ever criticise me.*'

- These self-invalidating patterns prompt him to adopt a behavioural pattern that is repeated in both his family and professional environmentSelf-fulfilling prophecy: his fear of rejection and conflict prompt him to base

his relationships on pleasing others. *'They only love me because it is in their own interest, they don't love me for who I am.'* Henry strives to do all the favours people ask of him without asking for anything in exchange, causing his relationships to be based on unconditionality, a situation that exacts a high emotional price.

- Fragmentation and dissociation: *'When I get overwhelmed by other people's demands, I prefer to function in auto and not think. I act like an amoeba so that it doesn't affect me, saying yes to everything and denying my own emotions.'*

Regarding his subservience to oppressive narratives, as a child, Henry had a rigid and perfectionist upbringing, never standing up to his father. He came to believe that the right thing was to constantly strive to be better and to do things only in accordance with duty, ignoring emotional wellbeing. There is also a social connotation that holds that being a man means being a tough guy who refuses to recognise any feelings of vulnerability.

Triggers

The triggers provoking this process of invalidation are linked to wounds in Henry's construction of his self-concept. As a child, he remembers himself as being curious and cheerful, but his father's rigidity and perfectionism inhibited him from making decisions. *'He never valued what I had, he only remarked on and criticised what I was lacking.'* Henry came to believe that deviating from the norm was always bad, explaining it to himself as '*I'm either perfect or I'm nothing*'.

He spent his adolescence as a timid, repressed teenager, always adapting to others to protect his own sense of worth. *'I had to be a saint in order to gain other people's affection.'* Currently, Henry imposes very strict rules on his teenage daughter, a circumstance that leads to fierce arguments at home. However, with his wife and work colleagues, he feels an excessive degree of internal rage that he finds difficult to express in front of fellow adults.

Maintenance factors

In relation to change, he is at the contemplative stage. He is aware of the problem, but change involves abandoning constructs that are important to his identity. For example, in two years' time he does not see himself being more *Lackadaisical*, *Closed* or *Brave*, even though these are constructs present in his Ideal Self. '*I am always striving to improve and I know one day I will reach perfection.*' His denial of reality, in which something is always missing, makes him feel ambivalent in relation to change.

He considers the emotional field to be an incapacitating internal model. Feelings such as fear, sadness or anger make him feel weak and lead to the use of denial and dissociation as coping mechanisms. Consequently, he considers himself to be fairly *Emotionally weak*, very *Fearful* and fairly *Phony* when relating to himself

and others.

Henry's problem also has an egodystonic element. His denial of his emotions and the fact that he is highly *Perfectionist* prompt him to believe that his form of relating to people does not cause any external problems. However, his reason for seeking help suggests that it does in fact cause conflict with himself,

Reconstruction process

The combination of predisposing factors, triggers and maintenance factors has hindered Henry's process of reconstructing his meaning system. The information collected using the FCM-FRP model helped established the goals, strategies, techniques and tools required for this clinical case.

In Henry's case, the therapeutic goals are:

1. To identify and express emotions in situations of conflict, in order to decrease denial and dissociation.
2. To enhance social skills such as negotiation and conflict resolution to help establish boundaries in his relationships with work colleagues, his father, his wife and his daughter.
3. To include gratifying activities in his routine, during which he can relate to the principle of pleasure.
4. To reduce the distance between his Self-Now and his Ideal-Self in order to reconstruct a more positive self-concept.

The strategies used in this clinical case are based mainly on an integrative constructivist intervention that uses fuzzy logic to work on scenarios of conflict. A FCM will be used as a simulation tool to develop these dynamics of change.

- Goals 1 and 2 will be attained by talking about situations of conflict and clarifying possible alternatives.
- In goal 3, we will focus on Henry's relationship with his ability to enjoy himself, keeping to the established time frame.
- Goal 4 will focus mainly on the emotional domain every time any progress is made, thereby validating it in his process of change.

The techniques and tools used most frequently in the therapeutic process are: emotional psychoeducation; exploring the reasons for his difficulties establishing boundaries, linking it to his life history; problem-solving techniques; assertiveness training; modelling; establishing boundaries; and using FCMs to simulate the dynamics of change.

Resources and Competencies

Regarding the resources and competencies that may facilitate change, Henry values the relationships he has and has an altruistic attitude and a keen interest in maintaining the bonds he has forged. Although he has trouble caring for himself emotionally, he nevertheless has the capacity for self-care, maintaining a healthy lifestyle, eating well and staying fit through sport. Moreover, the fact that he feels

comfortable in a normative environment helps him accept the commitment required by therapy. Being valued at work and knowing how to work as part of a team are qualities conducive to the collaborative patient-therapist model.

Despite having low self-esteem, Henry has certain expectations of his own self-efficacy, considering himself to be quite *Intelligent*, very *Generous*, fairly *Protective*, very *Hard-working*, very *Organised*, very *Persevering*, very *Creative* and very *Well mannered*. However, in relation to his Ideal-Self, he would like to be less *Well mannered*, *Creative*, *Organised*, *Generous*, *Protective* and *Hard-working* (see Henry's Grid, Figure 6). This is a positive indicator for the inclusion of flexibility and the emotional domain in Henry.

Figure 6
Results of the Repertory Grid Technique (RGT)

	Myself now - 1	Myself in two years - 2	Father - 3	Mother - 4	Wife - 5	Brother - 6	7 - Sister	8 - Friend	9 - Stepsister	10 - Non grata	11 - Co-worker	12 - Ideal self	
1. Perfectionist (1)	1	1	1	5	6	2	6	2	7	4	3	5	(1) 1. Flexible
2. Intelligent (2)	3	3	5	5	2	2	5	1	6	7	7	3	(2) 2. Stupid
3. Generous (3)	1	2	2	2	1	1	3	3	6	7	6	3	(3) 3. Selfish
4. Individualist (4)	4	7	5	5	3	7	5	3	1	1	2	7	(4) 4. Prioritizes family
5. Protective (5)	2	1	1	5	1	1	2	4	7	2	6	3	(5) 5. Hippie
6. Tolerant (6)	1	2	2	6	1	3	1	4	6	5	4	5	(6) 6. Assertive
7. Hard working (7)	1	2	1	1	1	1	2	3	7	5	5	2	(7) 7. Lazy
8. Organized (8)	1	2	1	4	6	1	5	2	7	3	3	2	(8) 8. Chaotic
9. Perseverant (9)	1	1	3	4	6	2	5	1	2	5	6	1	(9) 9. Careless
10.weak (10)	2	5	1	3	6	6	3	6	1	1	2	7	(10) 10. Emotionally strong
11. Fearful (11)	1	3	1	3	6	6	3	7	1	5	5	6	(11) 11. Brave
12. Creative (12)	1	3	6	4	5	5	2	7	2	7	7	2	(12) 12. Insensitive
13. Phony (13)	2	5	3	6	7	6	6	5	4	2	1	7	(13) 13. Sincere
14. Well mannered (14)	1	1	6	2	5	4	1	5	7	7	7	2	(14) 14. Badly behaved

Motivation

Henry is motivated to change because he does not feel good emotionally. His relationship with his wife and daughter has deteriorated and he wants to strengthen his family bonds. His desire to develop more social skills to enable him to state his point of view, connect with his ability to enjoy himself and make his own decisions constitute his main motivations to change. Henry believes that his capacity for hard work and perseverance will help him to attain the therapeutic change towards which he is striving.

Difficulties

Although Henry is motivated to change, he is concerned about reconstructing the constructs of his PMS. One of the goals about which he is very clear is that he wants to be very *Sincere* and *Emotionally strong*. However, he considers the emotional domain to be an incapacitating internal model that may hamper the process of change. The pain generated by looking at conflicts results in emotions

being dissociated, distancing his Self-Now from his Ideal-Self. Using FCMs as a tool for simulating change may help to allay his fears, bringing him closer to his problems in a more integrative and holistic manner.

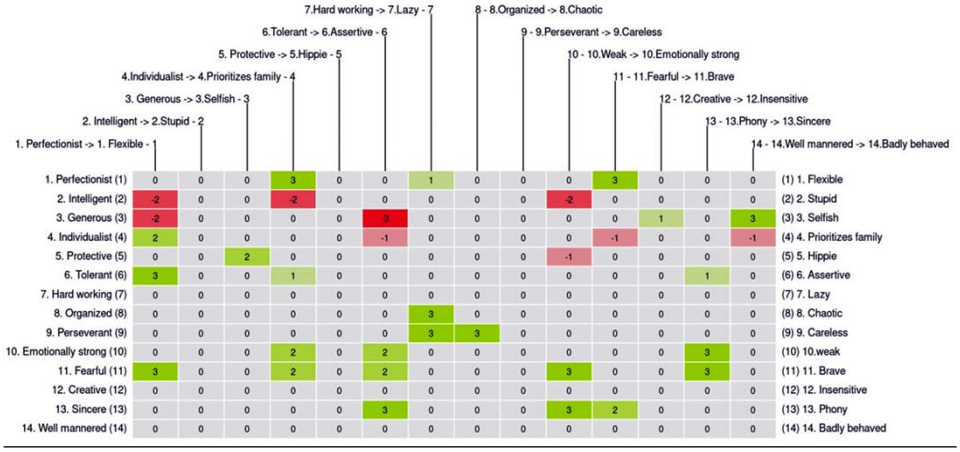
Therapeutic Intervention using FCMs

During the 1970s, there was a debate regarding the distance that should be maintained between research and clinical work. It was not until the 1980s that the two fields began to work together, conducting the first studies on the therapeutic process and the process of change (Orlinsky & Howard, 1986). The procedure followed in this clinical case was based on the recommendations made by Boswell et al. (2018) for implementing case studies in Practice-Oriented Research (POR), the aim of which is for researchers and clinical practitioners to work together to develop intervention programmes, involving all relevant stakeholders (researchers-patient-therapist), providing feedback about the implementation process, establishing clear priorities and maintaining a flexible attitude. Moreover, the following goals were also pursued throughout the entire procedure: to develop research proposals that will prove useful for both clinicians and researchers; to design research programmes based on clinicians' experience and expertise; to obtain more accessible and/or processable research results for clinical practice; to provide tools for collaboration and to motivate clinicians to collaborate; and to encourage researchers to be more open to the interests and needs of clinical practice (Fernández-Álvarez & Castonguay, 2018).

Based on the model developed by Gutiérrez et al. (2012), the process of compiling Henry's FCM and then analysing the simulated dynamics comprised the following stages: a) identification of congruent (those in which the Self-Now and the Ideal-Self are at the same pole) and incongruent construct pairs (those in which the Self-Now and the Ideal-Self are at opposite poles); b) determination of the causal relations between said pairs; c) assignation of intensities between nodes, obtaining the outcomes represented in the adjacent implication matrix; d) construction of the FCM to develop prediction scenarios; and e) simulating different scenarios in order to find the most stable FCM.

To this end, once we had compiled Henry's RG (see Ffigure 6), we compiled his ImpGrid. The resulting grid is shown in Figure 7.

Figure 7
Implications Grid (ImpGrid)

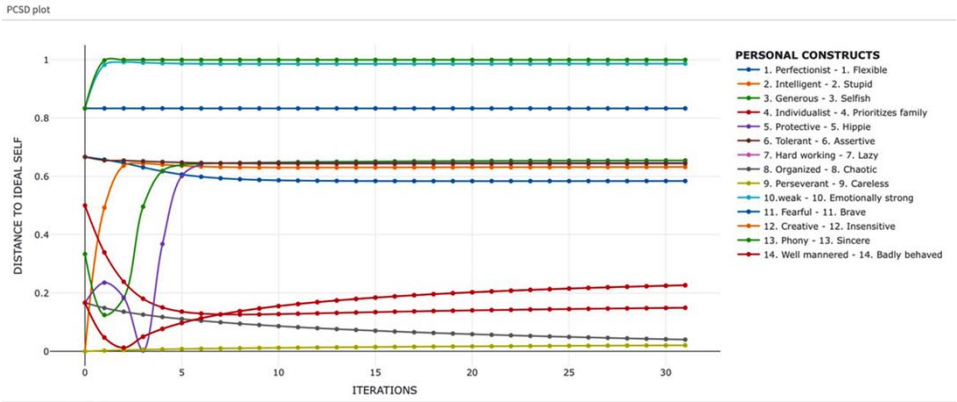


The Personal Construct System Dynamics (PCSD) graph obtained using the GridFCM program (Sanfeliciano & Saúl, 2022) represents the dynamics of Henry's personal constructs, simulating its hypothetical evolution over time (see Figure 5). This analysis offers us a view of Henry's possible patterns of change in relation to his PMS. In other words, it provides information about the difficulties and contingencies associated with his desire for change.

As shown in Figure 8, the discrepant construct pairs *Phony-Sincere* (0.96), *Emotionally weak-strong* (0.95) and *Fearful-Brave* (0.80) are close to AUC = 1, suggesting that Henry will have difficulty changing these constructs over time. In other words, in his Self-Now, he considers himself to be fairly *Phony*, fairly *Weak* and very *Fearful*, and even though his Ideal-Self is at the opposite end of these three nodes, this change is likely to prove more difficult than in other constructs. Consequently, the program proposes discrepant construct pairs that are more accessible to change over time, such as, for example, *Individualist-Family-minded* (0.14) and *Perfectionist-Flexible* (0.57) (see Figure 8).

Using PCSD is clinically very helpful, since in a single image, it makes different proposals for working on those constructs that are more open to change. It provides a roadmap that complements the FCM, with the two tools complementing each other to enable a more accurate analysis of the same dynamics of change from different perspectives.

Figure 8
Personal Construct System Dynamics (PCSD) graph and AUC index



Summary | AUC | Stability | PCSD Derivative

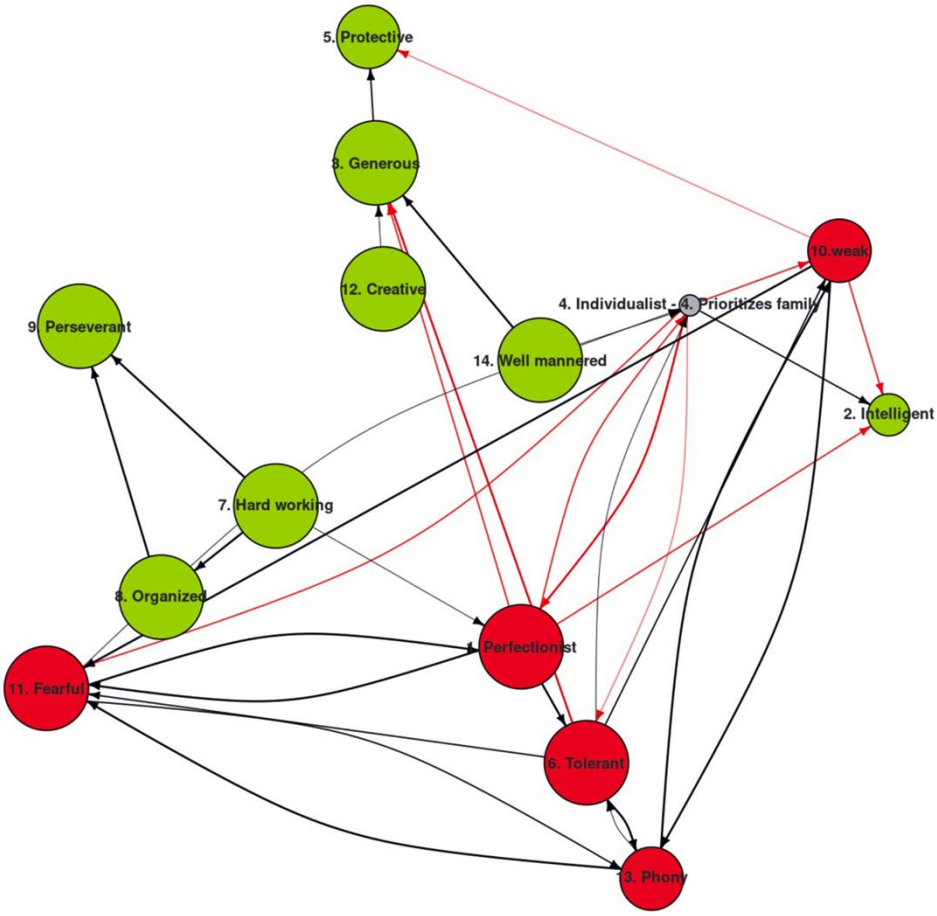
	AUC
13. Phony - 13. Sincere	0.9659136
10.weak - 10. Emotionally strong	0.9534494
11. Fearful - 11. Brave	0.8069626
6. Tolerant - 6. Assertive	0.6254867
2. Intelligent - 2. Stupid	0.5998800
3. Generous - 3. Selfish	0.5877922
1. Perfectionist - 1. Flexible	0.5755664
5. Protective - 5. Hippie	0.5609025
7. Hard working - 7. Lazy	0.1611644
12. Creative - 12. Insensitive	0.1611644
14. Well mannered - 14. Badly behaved	0.1611644
4. Individualist - 4. Prioritizes family	0.1498619
8. Organized - 8. Chaotic	0.0751719
9. Perseverant - 9. Careless	0.0135857

Note: AUC: Area Under the Curve. Values between 0 and 1. The closer the value to 1, the more difficult it will be to change the construct.

In Henry's initial PMS map (see Figure 9), the constructs *Perfectionist, Well mannered* and *Hard-working* occupy a more central position, indicating their importance in the system. We can therefore say that being a *Perfectionist* is one of the reasons why Henry is too *Tolerant* and *Phony* in relation to his needs and wishes. This feedback has serious social-affective consequences for his relationship with his wife and daughter.

Figure 9

Initial Structured Map in accordance with the Centrality of the Constructs (Reingold-Tilford Model)



Using FCMs as Simulators of Change

The intervention with Henry mainly comprised working on scenes of conflict using the FCM as a simulator of change. Developing these dynamics of change from the perspective of an observer helped Henry play a more active role in his own therapeutic process, bringing these dynamics closer to his real life. In this section we will present a series of examples of how FCMs could be used in Henry's case.

The Loopy computer program (Case, 2022) was used to display the dynamics of the PMS. Loopy shows the polarity of each construct pair (nodes) with a colour code that indicates the position of the Self-Now in relation to the Ideal-Self (red: incongruent construct, green: congruent construct, yellow: dilemmatic construct in which the ideal is in an indeterminate position). The amount of colour shown

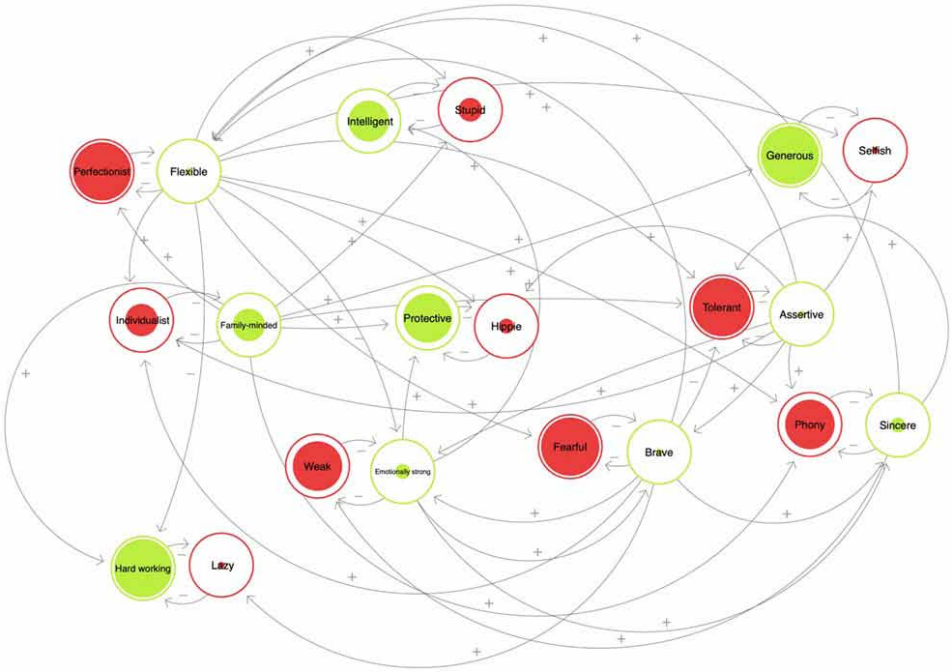
depends on the Self-Now scores awarded in the RG on a 7-point Likert-type scale (from 1-7) (*relationship weights, see Figure 6*). Next, the positive (+) or negative (-) causal implications are drawn using arrows that connect some nodes with others (relationship edges). The combination of nodes and edges represents how Henry's personal meaning system is construed. The activation of one node (one pole in the construct pair) impacts the entire system, creating a new FCM that simulates change: '*What would happen if....?*'. This enables us to link conflict situations with possible scenarios of change for the patient.

Re-compiling the Personal Meaning System

Once the RG and ImpGrid had been completed, we saw that Henry's FCM had a system of personal meanings based on the 'all or nothing' dichotomy, a situation that made therapeutic change more difficult. The corset of perfection rendered his construct pairs very rigid, preventing him from seeing the different nuances present in each ideal pole (see Figure 10) (https://bit.ly/3RRUD7f).

Due to this dichotomy, some construct pairs had conflicting causal implications, prompting us to invite Henry to review his network of personal meanings in conjunction with his life history. The following discrepant pairs were analysed: *Fearful–Brave*, *Tolerant–Closed*, *Phony–Sincere*, *Perfectionist–Lackadaisical*, *Emotionally Weak–Strong* and *Individualist–Family-minded*.

Figure 10
Loopy Representation of Henry's FCM at the Start of his Treatment



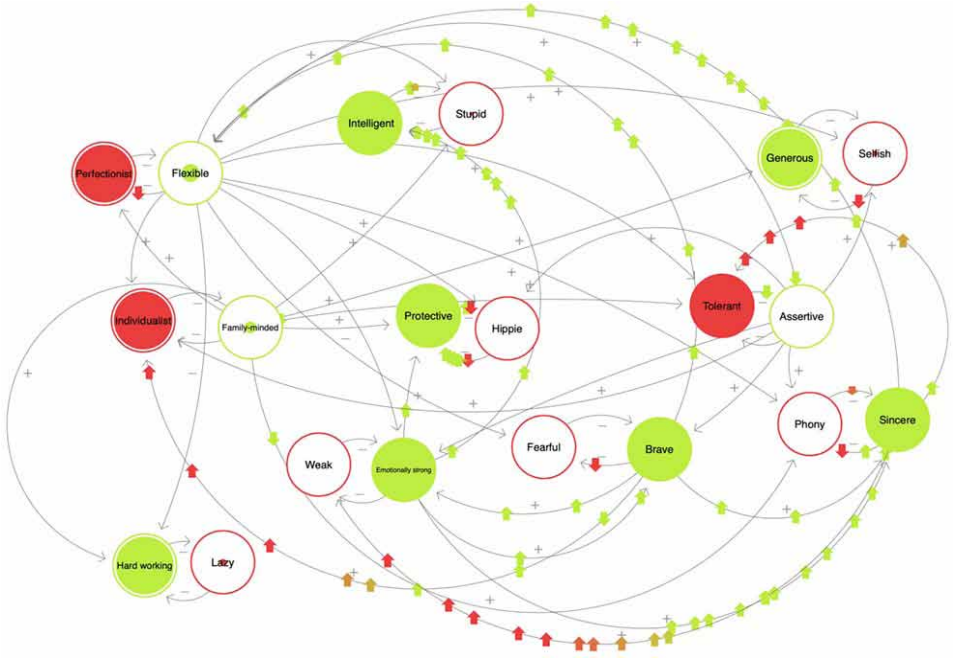
To carry out the intervention, we first revisited the meaning of each ideal construct (*Brave, Closed, Sincere, Lackadaisical, Emotionally Strong* and *Family-minded*). Next, we asked Henry to think of a real or imagined situation in which he would like to be at this ideal pole. For example: '*At work, my boss got annoyed with me because he thought I had made a mistake. It was actually my colleagues who had made the mistake, but I was unable to tell him that.'* In this situation, we took the ideal construct *Brave* as our frame of reference and carried out a change simulation in Henry's FCM. *'Imagine you are as brave as you would like to be and you tell your boss that you do not agree with his decision. Would this bravery mean that you were more or less...?'.* (https://bit.ly/48v2r4u)

After this intervention, Henry modified the implications of being *Brave*, reducing their number in comparison with his previous map, in which he had thought that being *Brave* would make him more *Lazy*. Now, being *Brave* is the cause of being more *Lackadaisical*, more *Sincere*, more *Individualist* and *Emotionally stronger* (see Figure 11).

The map offers the patient the opportunity of simulating the dynamics of change in order to imagine what would happen if, in this case, Henry had moved to the desired pole, being *Brave* in accordance with its current meaning. By activating the ideal construct with its new implications, Henry found that his map became

mostly green, indicating a greater degree of stability in his PMS.

Figure 11
Recompiling the Meaning of the Ideal Construct 'Brave'



During the following sessions, the same procedure was repeated, revisiting the meaning of other ideal constructs and using everyday scenarios to simulate change. Working with his FCM helped Henry to clarify and simplify the path he needed to follow during the process of change. '*Viewing everything in terms of small, everyday situations helps me to see the changes I can make. Everything is much simpler than it first appears.'*

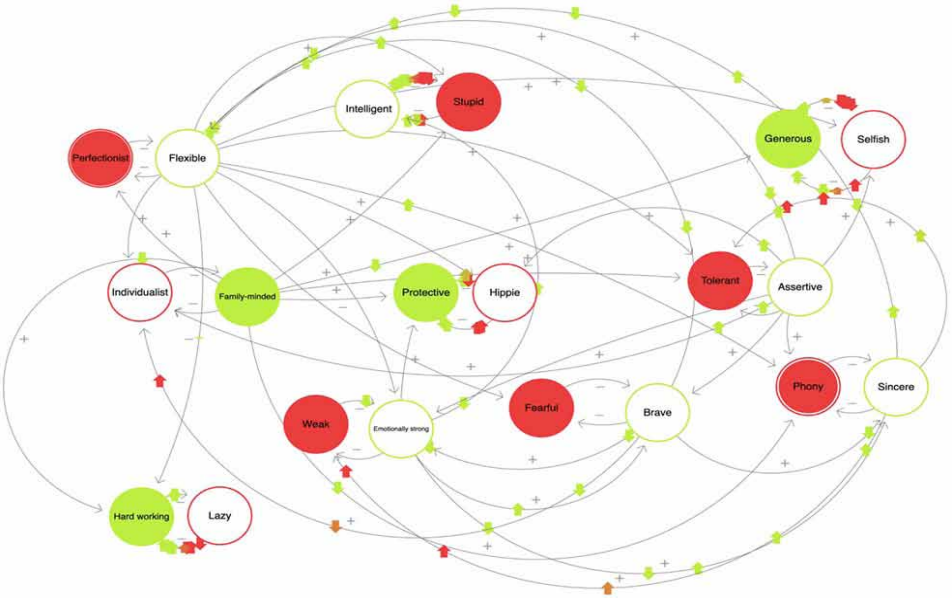
FCM in Relation to the patient's Life History

Another important focus is the exercise of linking the patient's personal meaning network with their life history. Henry manages his work relationships in much the same way as he manages his relationships in his personal life. He relates to everyone through rules and expects everyone else to do the same. The difficulty he experiences setting boundaries, his denial of his own anger and his lack of social skills mean that he has trouble connecting to reality, a circumstance that causes him a great deal of distress directed towards himself. This is one of the examples we will use to work on fuzzy logic.

Henry refuses to acknowledge his emotions and is so *Tolerant* with everyone that his feelings end up overwhelming him. Consequently, he wants to be more

Closed and to impose certain limits on his social relations. We activated the *Tolerant* construct to see what would happen if he continued to act in the same way: '*My map turned redder ... telling me that continuing down this path would make me feel as bad as always*' (see Figure 12).

Figure 12
FCM with No Process of Change in relation to the Incongruent Pair Tolerant-Closed



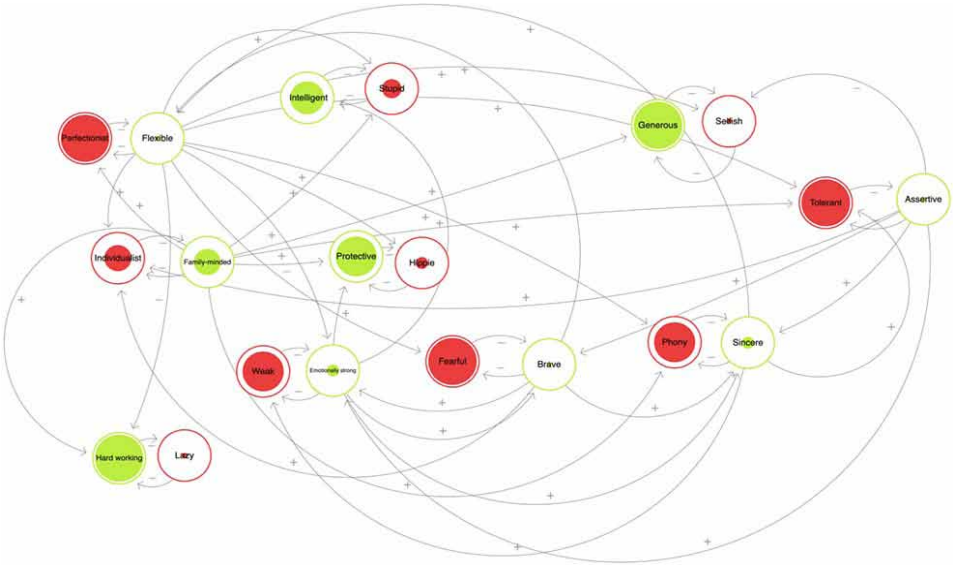
The FCM offered Henry the opportunity to simulate different dynamics of change, seeing what would happen if he managed to move to the other pole and become more *Closed*. Beforehand, however, we reviewed the meaning of this construct and its implications. Due to his dichotomous principal of reality, which is based on all or nothing, Henry had trouble redefining the construct of the ideal pole. The same thing happened with the Brave construct, so we decided to stop for a while in order to link it to his life history.

A rigid, authoritarian father figure who refused to validate him prompted Henry to build a personal construct system based on perfection: '*You are either perfect or you are nothing*'. He also traced support figures and resources that helped him form a more positive self-concept, and even though he identified a few figures outside his immediate family circle, they did not have a major influence on him during the early stages of his life.

In light of this biographical information, Henry was invited to simulate his own meaning system beyond that which was constructed during his childhood. In his response, he changed the construct *Closed* to a more open and amiable one: *Assertive*. From his role as an observer, being reminded of the simulation scenario

helped him create his own system of meanings. *'Imagine you have this assertiveness, generated in accordance with what YOU want to be, and that you manage situation x on that basis. Would this assertiveness mean that you were more or less...?'.* (https://bit.ly/4apZF29). In the *Tolerant-Assertive* pair, Henry modified the implications that caused him to be *Assertive*, eliminating (in comparison with the previous FCM) being more *Hippie*, more *Lackadaisical* and *Phonier,* since he no longer considered them to be constructs linked to being *Assertive*. He also changed to being less *Selfish* (see Figure 13).

Figure 13
FCM as a Simulator of Change in relation to the Incongruent Pair Tolerant-Assertive



In another example, the name of the ideal pole of the incongruent pair *Perfectionist-Lackadaisical* was also changed. After several sessions working on his relationship with his father, the construct *Lackadaisical* was renamed *Flexible*, thereby adding a more positive connotation. Being *Flexible* is the cause of being more *Intelligent*, more *Assertive*, more *Generous*, more *Family-minded* and *Braver* (see Figure 14) (https://bit.ly/3RQkdJR). *'Seeing the arrows linking to lackadaisical (more individualistic, less hard-working, less fearful, emotionally stronger, more hippie, phonier, more tolerant, more selfish and more stupid) really had an impression on me. How could I have thought that was what I wanted to be?'*

The Dynamics of Change based on two Different FCMs

Another way of increasing a patient's insight into their meaning system and the possibilities for change is to activate the map in two different screens. In Henry's case, activating the original FCM he compiled at the beginning (see Figure 10)

alongside the new FCM compiled following the simulated change (see Figure 15) helped him confirm the pathway to change that he had reconstructed from an adult perspective. '*Seeing the two maps side by side made me aware that I had taken the wrong path. I thought that perfection would give me peace of mind and that I would have no problems, but it's just the opposite.*' Henry's FCM enabled him to go back in time, analysing how he could construct his meaning system on the basis of scenarios simulated in accordance with the past, present and future of his life history.

Figure 14
FCM as a Simulator of Change in relation to the Incongruent Pair Perfectionist-Flexible

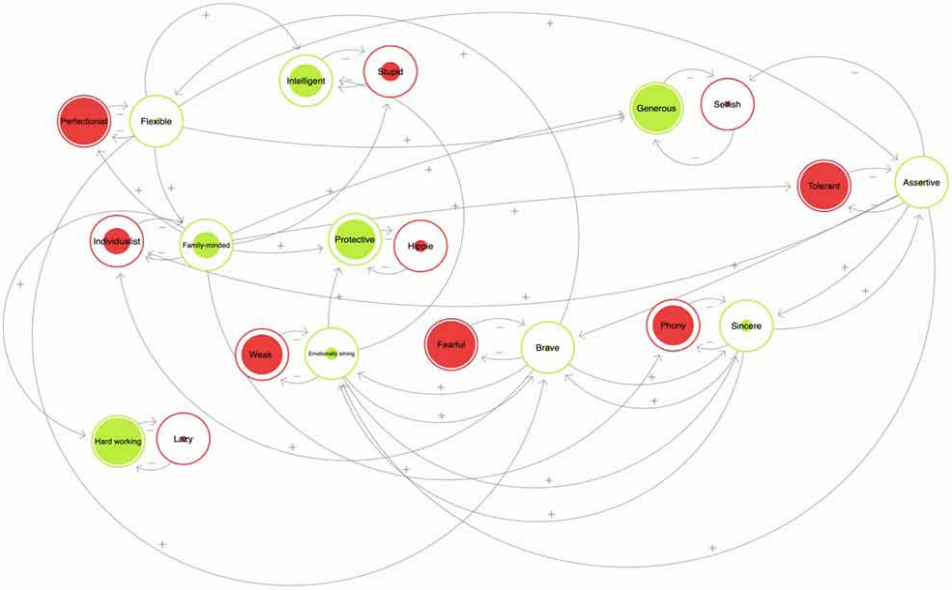
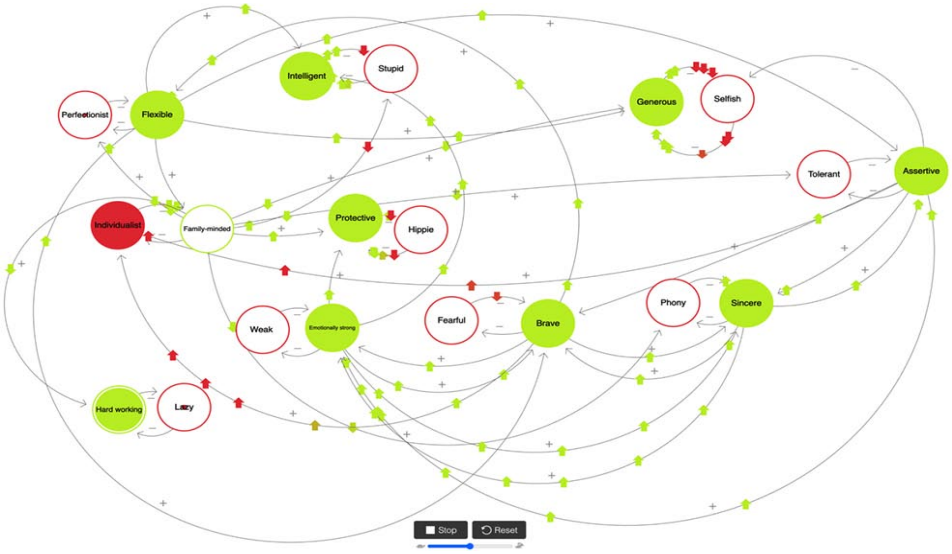


Figure 15
FCM during the Final Treatment Sessions



- In these examples, we see that using the FCM as a means of simulating change enables us to analyse two possible scenarios and think about them together with the pati*What would happen in your life if you moved towards the desired pole? How would that affect the rest of the constructs?*
- *What would happen in your life if you followed the same dynamics and remained at the same undesired pole? How would that affect the rest of the constructs?*

After these sessions, the patient stopped being an observer and became the protagonist, making use of the flexibility present in his daily routine, activating his capacity for self-care and embracing his emotional world, distinguishing between weakness and vulnerability. *'I find that, if I'm tired and look after myself, I'm also looking after my relationships with others.'* Henry found a *Self-Now* that was more *Assertive, Sincere, Flexible* and *Brave*.

Therapy is a mirror in which to see oneself and the therapist made the most of this moment to reflect a greater degree of congruence between the Self-Now and the Ideal-Self. However, on other occasions, becoming aware of his Self-Now in relation to his Ideal-Self provoked an anxious-depressive response in Henry, since, in this case, a therapeutic gain implied a loss in lifestyle in relation to his idealism and perfectionism. The map forced him to confront the way his life was developing and to question whether or not it was what he really wanted. *'It hurts to see it, but this is not the way I want to move forward. I've spent many years functioning like this and it's hard for me to let go, but seeing my map so red is like banging my head against a brick wall, time and time again.'* The therapist accompanied Henry in this

process of loss, encouraging him to keep working and reminding him that when you establish a pattern of relationships based on a different dynamic of change, you achieve a greater degree of wellbeing.

After activating the map during several sessions, Henry started to feel more connected with the principle of reality, facing up to his idealisation and beginning the necessary process of change towards validating what he has, rather than focusing on what he lacks.

In conclusion, we can say that as the therapeutic process advanced, Henry developed a less conflictive system of meanings. His FCM showed him different pathways towards striking a balance between desire and duty, connecting with his capacity to enjoy life and to practice emotional self-care. *'I've decided to focus on what I can change in order to feel better.'*

The factors that helped Henry feel more stable in his new PMS were:

- Reworking his meaning system in accordance with desired constructs and reducing those meanings that were in conflict. This enabled him to understand the emotional cost of trying to live up to an ideal, and to accept the limits of his relationships with others.
- Moving away from the 'all or nothing' dichotomy and introducing nuances into his construct system (very, fairly, quite). Becoming aware of the differing degrees of intensity that exist within a pole enabled him to adopt a more active attitude towards his process of change.
- Identifying and accepting conflictive relational patterns linked to his life history help him build his own network of personal meanings.

Conclusions

Listening and Responding to the Patient's Demands, and treating each case as unique

From the perspective of constructivist epistemology, it is necessary to understand the patient's inner world in order to understand their demand for change. To this end, the therapist must previously connect with the patient's life history and make sure that the data collected in the grids have a bearing on their demand. In this sense, FCMs become a reflection of the patient's PMS, on which patient and therapist work together to create pathways of change.

Using scenarios of conflict from the patient's own life as examples for simulating change may help them adopt a more active role in the therapeutic process. '*Viewing everything in terms of small, everyday situations helps me to see the changes I could make. Everything is much simpler than it first appears.'*

Avoiding standardised, universal intervention procedures enables the therapist to reconstruct the patient's PMS in a unique way. During the process of change, it is the patient him or herself who sets the pace and the therapist who accompanies them on that journey. To this end, FCMs are a single tool that can be used for both

reconstructing the patient's PMS and analysing the dynamics of change from a unique and customised perspective.

Therapeutic Alliance based on the Collaborative Model

This case was based on the collaborative model (Botella, 2020) in which the patients is the protagonist of change and, alongside the therapist, establishes a co-constructive relationship based on a working alliance. The role of the therapist is to mediate between the patient and their demand for change, so that together, they can explore their network of personal meanings. Several studies on the effect of therapist-patient compatibility have shown that resistant patients develop better working alliances with more flexible and less directive therapists (Botella, 2020). One study that sought to identify the factors that influence breakdowns in therapeutic alliances with patients who have difficulty establishing and maintaining interpersonal relationships confirmed that tension in the therapist-patient bond strengthens the process of change when therapy is based on a collaborative model (Valdés et al., 2018). Consequently, using FCMs as flexible tools that can be adapted to the patient's own structure may help facilitate change in this type of patient.

Creating Scenarios as Simulators of Change

FCMs help generate a dynamic representation of the patient's PMS with a twofold purpose: to show the pathway to follow in accordance with the patient's change goals and to turn the therapeutic space into a more natural laboratory with greater interactive capacity between patient and therapist.

Proposing change scenarios using a simulation tool can help the patient to identify key aspects of the therapeutic process: adopting an active attitude, recovering a sense of capacity and becoming aware of their ability to do something differently.

The novelty of using FCMs in conjunction with the patient's PMS is that they provide a dynamic rather than static overview of the causal relationships between each construct and all the others. Moreover, the PCSD graph provides, in a single image, feedback about both synchronous and diachronic patterns of change; and having this information available in this format lends clarity and usefulness to clinical practice.

The simulation enables all parties involved to perceive the change from the role of observers, analysing the patient's PMS from outside.

Becoming Aware and Adopting an Active Attitude in Psychotherapy

The awareness generated by FCMs provides feedback about the Self-Now and the Ideal-Self. This feedback helps the patient to redefine their PMS, mobilising them towards therapeutic change. Moreover, the map acts as a protective element in the therapeutic relationship, since it is the scenario that forces the patient to confront their reality, not the therapist.

Furthermore, prioritising clinical methodology over research methodology

encourages patients to play an active role in the process of change. According to the principle of irrelevance, in a complex system, greater precision leads to more irrelevant outcomes. The rigidity of precision causes other variables to be lost, and collecting data in this way is not particularly useful for designing cases that are unique to each patient.

In a process of psychological assessment, the patient plays an active role in the data collection process, through the grid techniques. Therapist and patient work together as individuals in a team, and the FCM ensures an active attitude right from the beginning of the therapeutic process.

Monitoring Change

Using fuzzy logic in psychotherapy enables constant monitoring of the therapeutic change through both the FCM and the PCSD graph. Having a record of all the dynamics of change that occur throughout the therapeutic process is of incalculable value in both clinical practice and research. Moreover, we can analyse how the patient construes their system of meanings, creating scenarios that simulate change in the past, present and future. FCMs are useful in both the diagnosis and intervention phases of psychotherapy, enabling ongoing monitoring of the process of change.

This monitoring does not focus so much on the elements themselves, but rather on the dynamics of change that emerge within the patient's PMS. In other words, FCMs constitute a tool that enables a reworking of the patient's network of personal meanings, alongside an analysis of their dynamics of change. Consequently, the final outcome goes beyond behaviour to involve a structural change also.

Limitations

It is vital to have a prior knowledge of and training in the logic of fuzzy sets as applied to the construction of FCMs in psychotherapy. Despite the time and effort this involves, this knowledge is essential to interpreting the data and providing simple, consistent feedback within a single graph.

To avoid indirect implications on the map and ensure clearer data, the ImpGrid application protocol needs to be refined and simplified. In the Constructivist Research Group at the UNED (GICUNED, https://blogs.uned.es/gicuned/), we are currently working on simplifying this protocol in order to make this complex system clearer and easier to work with in clinical practice.

Since we use fuzzy logic and FCMs as tools for simulating change in cases that are viewed and dealt with as unique, it is impossible to compile a universal manual that can be applied to all patients. Much more useful would be to develop a roadmap for using fuzzy logic in psychotherapy.

The outcomes constitute a non-linear approach using qualitative data. Despite the high level of external validity offered by the tool, it is difficult to mathematically quantify the data collected using this format. If the Loopy application were connected to the adjacency matrix, the feedback received about the process of change

would be more immediate. This in turn would help enhance the patient's insight, providing them with a stronger feeling of control over the changes being generated.

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