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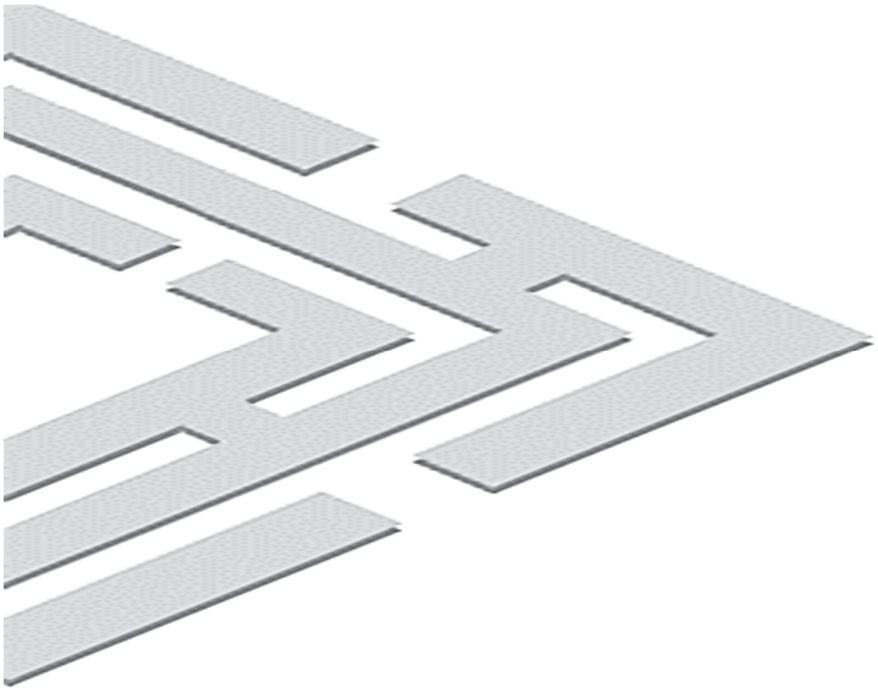

Remembering sounds in the brain: from locationist findings to dynamic connectivity research

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Abstract

Our world is full of sounds, either verbal or non-verbal, pleasant or unpleasant, meaningful or simply irrelevant noise. Understanding, memorizing, and predicting the sounds, even non-verbal ones which our environment is full of, is a complex perceptuo-cognitive function that we constantly refine by everyday experience and learning. Musical sounds are a peculiar case due to their culture-dependent complexity and hierarchical organization requiring cognitive functions such as memory to be understood, and due to the presence of individuals (musicians) who dedicate their lifetime to master the specifics of those sounds and rules. Thus far, most of the neuroimaging research focused on verbal sounds and how they are processed and stored in the human brain. Only recently, researchers have tried to elucidate the neural mechanisms and structures allowing non-verbal, musical sounds to be modeled, predicted and remembered. However, those neuroimaging studies often

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provide only a mere snapshot of a complex dynamic process unfolding over time. To capture the complexity of musical memory and cognition, new methods are needed. A promising analysis method is dynamic functional connectivity, which assumes that functional connectivity changes in a short time. We conclude that moving from a locationist to a dynamic perspective on auditory memory might allow us to finally comprehend the neural mechanisms that regulate encoding and retrieval of sounds.

Keywords: auditory memory, pattern recognition, brain spatiotemporal dynamics, dynamic functional connectivity, music neuroscience.

Introduction

Since we are born, and even earlier, we are immersed in a sound-rich environment and even in a vacuum, we start hearing noises from our own bodies (Kolata, 1984; Parga *et al.*, 2018). These sounds whether verbal or non-verbal, pleasant or unpleasant, meaningful or simply irrelevant noise, constitute the ever-changing stream impinging on our ears and brains and changing them continuously by neuroplastic processes. Thanks to these perceptual-learning and neuroplastic processes commencing even before birth, we possess a complex perceptuo-cognitive function that allows us to understand, memorize, predicting, recognize and finally attribute meaning to sounds (Brattico & Varankaite, 2019; Brattico, 2019; Gebauer, Kringelbach & Vuust, 2015; Hallam, 2018).

Musical sounds are a peculiar case due to their culture-dependent complexity and hierarchical organization requiring several cognitive functions, such as memory and attention, to be understood. Moreover, since thousands of years human cultures and societies nurture and educate individuals (musicians) who dedicate their life to master the specifics of those sounds and rules, resulting in highly specialized auditory processing skills dependent on neuroplastic processes (Altenmüller & Furuya, 2017; Brattico *et al.*, 2021; Reybrouck, Vuust & Brattico, 2018; Criscuolo *et al.*, 2022). To date, however, the psychological and neural mechanisms that permit learning, recognition and memory for complex musical sounds remain unclear.

Most research conducted on learning and memory, though focused

on visual and spatial information, has been conducted initially on brain-damaged patients, such as the classical study of Brenda Milner (1966) on H.M. which presented a long-term (LTM) episodic memory deterioration because of the removal of scar tissue on the bilateral hippocampus. Since the '90s (designated as the "Decade of the Brain" by US President George W. Bush), studies on memory in healthy subjects have become possible thanks to functional techniques, such as magnetic resonance (fMRI), electroencephalography (EEG) or magnetoencephalography (MEG). With these techniques, it was possible to investigate encoding, storage, retrieval, and predictive processes of mainly verbal or visuospatial information, with a small minority of studies on auditory non-verbal or musical information. While providing valuable information supporting and complementing knowledge previously obtained from brain-lesioned patients, the neuroimaging studies focused on regional brain activations, and static connections during memory tasks (Van den Heuvel & Hulshoff Pol, 2010), leaving it open the question on the dynamic fast network changes during memory processes for sounds evolving in time. In this review we wish to first provide an overview of neuroimaging findings on memory for musical sounds and then present the frontiers of research on dynamic connectome for music.

Memorizing sounds over time: the peculiar case of music

Based on the current literature, there is a scarcity of models focused on non-verbal auditory information, since most of the studies focus on visual, verbal or spatial memory. In the following sections we will briefly summarize the main theories that have been proposed to explain the storage mechanisms of non-verbal auditory and musical information, with a focus on different memory systems: sensory memory, working memory (WM) and long-term memory (LTM).

Sensory memory has been measured for the first time by Sperling (1963) and subsequently integrated on the multi-store model of memory by Atkinson & Shiffrin (1968), a theory which postulates that sensory information (auditory information included) passes through sensory and short-term memory storages, before being lost (due to decay or interference) or permanently consolidated on LTM (see also

Broadbent, 1958; Cowan, 1984, 1988), In relation to auditory sensory memory (or echoic memory), for example, it has been demonstrated that subjects are able to recognize differences between two similar sounds only when these sounds are presented less than 10 seconds from each other (Cowan, 1984), with a decline in performance when similar sounds are presented in between as interfering stimuli (Cowan, 1984; Deutsch, 1975; Massaro, 1970). When sounds are separated by a silent period, subjects can compare them only when they are very different from each other. Such degradation of sensory signal appears to comply with the idea that once the memory trace related to the first sound is deleted by the sensory buffer, subjects can rely only on the store having a higher retention range. Store that, however, can contain sound information with much lower resolution than that of the sensory buffer. Most of these results have been obtained with classical paradigms like, for example, the oddball task, which consists in the presentation of repeated stimuli occasionally interrupted by a deviant stimulus.

WM (Baddeley & Hitch, 1974) is defined as the system behind complex cognitive abilities, a system on which cognitive processing and reasoning rely. Auditory WM allows not only to to recognize and to learn the various features of sound (e.g., pitch, tempo or timbre), but also to integrate them in a spectrally and temporally complex way, e.g., for consonance, tonality, rhythm, allowing understanding and appreciation of music (Seashore, 1937). The classical experiments conducted by Diana Deutsch (1999) demonstrated that auditory WM does exactly that: it maintains different sound features, like timbre or pitch, and recombines them for more advanced stages of cognitive processing. One of the most used paradigms used in WM studies, including auditory ones, is n-back of isolated sounds, in which a sequence of stimuli is presented, and the subject is asked to indicate if the current stimulus is the same or different to the stimulus presented N trials back. Another very common paradigm for studying auditory WM is the delayed response task, in which a stimulus is presented and then extinct, and after a variable amount of time the same stimulus and a similar one are presented to a subject, who is asked to identify the original stimulus.

The longest-lasting and largest-capacity memory system is LTM. Numerous experiments have been conducted to understand which

sound features (e.g., pitch, rhythm, timbre) are most involved in the recognition of familiar melodies (for example, "Summertime" by G. Gershwin can be recognized simply from the few notes of the incipit). An experimental technique that is often utilized in music memory research is "octave scrambling", which consists in transposing a melody into different octaves while maintaining the order in which the different pitches are presented (Deutsch, 1972). With this technique it was seen that what makes melodies recognizable is the maintenance of the *contour*, that is, the *up* and *down* patterns of the various pitches, even when the melodies are decomposed into different octaves (Dowling, 1978).

Auditory recognition, however, tends to be worse than recognition in the visual (Cohen, Horowitz & Wolfe, 2009) or tactile sensory modalities. Bigelow and Poremba (2014) have examined memory recognition for visual (silent videos), auditory (complex sound of everyday life) and tactile (objects of common use hidden and presented in such a way that they can be touched and manipulated) stimuli, showing that auditory recognition is significantly worse than in other modalities, with no significant differences between visual or tactile stimuli. Cohen *et al.* (2009) have argued that auditory recognition is worse than other modalities due to our tendency to primarily rely on visual stimuli. This might explain why auditory recognition is weaker than visual recognition even among musicians (Cauda *et al.*, 2011).

Despite the classical subdivision between sensory memory, WM and LTM, the formation of new musical memories is an extremely dynamic process, which is the outcome of real time listening and predicting: the notes that we recognize in a melody are continuously unfolding and varying during listening and can be understood only based on the models and priors we have accumulated from life exposure to sounds (Dowling, Tillman & Ayers, 2002). Crowder *et al.* (1989) have conducted a study in which participants compared the pitches of a sine tone followed by a tone played by a musical instrument, evidencing that discrimination was faster the more familiar participants were with the timbre of the instrument. This might be due to the fact that LTM generates a mental image of the frequency of the pure tone as if it had been played in the timbre of the instrument used for the second sound. This and other findings inspired Cowan (1988, 1998, 1999) to propose that long-term memory consists of specialized subsystems or

activation mechanisms that process (auditory) sensory features of the stimulus alongside its long-term categorical representation. Although Cowan's models assume that some sensory features are maintained for longer periods of time, they do not explain the apparent contradiction between the classical findings on the limitations in accessing sensory information and its long-term retention. Even for recall, the melodies are never perfectly remembered note by note, but small variations are often produced, which remain metrically and harmonically coherent with the original (Sloboda, 1985). Hence, episodic LTM for melodies consists in the memorization of abstract patterns in which not necessarily all the superficial details are kept (Snyder, 2009). What remains of these details, however, has been a long controversial topic. Some theories are based on the idea of the importance of hierarchical structures, in which some musical events are structurally more important than others (Deutsch & Feroe, 1981; Lerdahl & Jackendoff, 1983). Most of these theories suggest that segmentation (a process which underlines the organization of musical events into groups) is a fundamental aspect for the creation of a long-term representation (Deliège, 1987).

A novel theory of brain function which has relevance also for music perception and memory studies is predictive coding theory (PCT), a Bayesian mathematical model of neural mechanisms initially used for visual perception (Rao & Ballard, 1999) and subsequently used to the prediction of behavior (Fitzgerald, Dolan & Friston, 2014). PCT concerns the hierarchical neuroarchitecture that allows and makes sense of the external or internal environment. When applied to music, PCT represents an attempt to understand how the human brain predicts, understands and memorizes sounds.

Predictive coding is based on the bidirectional flow of information in a hierarchical neural network (Friston, Stephan, Montague & Dolan, 2014), and, applying it to auditory perception, postulates how the succession of sounds is recorded and compared with pre-existing models which, if these sounds do not correspond to the models, are updated from time to time (for a review, cfr. Koelsch, Vuust & Friston, 2019). The higher representation units send their predictions to the lower units. The bottom-up input is compared with these top-down predictions and if there is a match between the input and the prediction, a suppressed neural response (which corresponds to the passive sensory adaptation mechanism) is obtained. Conversely, a mismatch causes a

prediction error response, measured with electroencephalography or magnetoencephalography as the mismatch negativity (MMN), which is projected back to the higher level (Kanai *et al.*, 2015). These neurological processes driving optimum deviant identification fluctuate according to gene-determined catecholamine levels in the brain, according to Bonetti *et al.* (2021a). As Vuust *et al.* (2022) state, a key concept in PCT is the idea that prediction mistakes are weighted by their precision (predictability). In other words, the brain must choose the prediction errors that drive Bayesian belief updating and the top-down predictions that follow. This can be thought of as a type of covert or mental action that gives ordinary predictive coding systems an active and attentional component. These theoretical models have mainly sought empirical confirmation in locationist research, including studies focused on the MMN brain response, which will be illustrated in the following section.

Locationist research on the neural bases of sensory memory for musical sounds

A deep understanding of non-verbal, and specifically, musical auditory memory requires the identification of its neural substrates and the mechanisms involved. For this purpose, the research with neuroimaging methods is crucial, as also highlighted in the most recent manuals of general psychology and memory (e.g., Baddeley, Eysenck & Anderson, 2020; Gatti & Vecchi, 2021). It should be noted, however, that neuroscience and neuroimaging studies have focused too mainly on the coding and recognition of visual, spatial (Aggleton & Brown, 2006; DiCarlo, Zoccolan & Rust, 2012) and verbal information than auditory ones. In the following sections we will review the few studies in the literature on the neural correlates of memory for musical sounds, starting from systemic neuroimaging studies, then moving on to neurophysiology studies to conclude with studies on dynamic functional connectivity.

In the sensory span, predictive processes, traditionally referred to as echoic memory processes, rely on interconnected neural structures that go from the peripheral to the central nervous system, namely the acoustic nerve, the primary and associative auditory cortex, the

superior temporal gyrus, the insula and the inferior frontal gyrus (Kanai *et al.*, 2015; Näätänen *et al.*, 2001; Tervaniemi & Hugdahl, 2003; Zatorre, 2003).

Neurophysiological research has demonstrated the coexistence of different mechanisms for coding and storing simple sound sequences by activating the aforementioned brain areas. The neurophysiological responses at the level of the auditory cortex adapt and attenuate with the repetition of tones in a sequence, at least until a new tone is introduced, as occurs with the oddball paradigm. This dampening of neuronal response related to forming predictions and the opposite enhancement related to signaling a change or error in expectation are studied by recording the mismatch negativity (MMN) and the N1 or N100, two kinds of brain responses evoked by stimuli, by means of EEG and MEG (Brattico, Näätänen & Tervaniemi, 2001; Brattico, Tervaniemi & Picton, 2003; Brattico *et al.*, 2009; Näätänen, Gaillard, & Mäntysalo, 1978; Näätänen *et al.*, 2007; Vuust *et al.*, 2011; Vuust *et al.*,, 2012). MMN reflects the formation of a neural representation of standard sound to which the deviant sound is related (Näätänen & Winkler, 1999): without this standard predictive sound encoding, no MMN could be generated (Cowan *et al.*, 1993). MMN is generated both in the primary auditory cortex (Alho *et al.*, 1986; Hari *et al.*, 1984; Kropotov *et al.*, 1995; Sams *et al.*, 1985) and in the frontal lobe after the attention switching that follows the stimuli changing, as proposed by Näätänen and Michie (1979) and then confirmed by various studies (e.g., Giard *et al.*, 1990; Rinne *et al.*, 2000).

Using a multi-feature MMN paradigm, Kliuchko *et al.* (2019) discovered that active listening experience in professional musicians enhances neuronal prediction errors above and beyond the effect of just listening to music. In particular, they observed larger MMN amplitudes, indicating a stronger brain response to violated priors, in jazz musicians (but not in classical musicians) as compared to non-musicians or amateurs. Participants who were not musicians but who loved jazz music, instead, showed a reduced MMN to pitch slide (a common feature in jazz music). These results suggest that priors learned from active vs. passive engagement with a musical style shape the auditory-cortex responses to deviations of spectral features (such as timbre, pitch and slide) inserted in an ever-changing fast musical sequence. For example, professional jazz musicians display a more accurate

neural discrimination of pitch, pitch slide, timbre and intensity changes, as indexed by the MMN response. Furthermore, a higher preference for a musical style in non-musicians or amateurs was associated with a reduced MMN response to pitch slide, which is the opposite to the effect of music playing experience in the same population. This suggests that active experience of a musical style is crucial for developing accurate priors and consequently an enhanced automatic neural discrimination of the sound features of the preferred style, in contrast to a passive experience of it (Kliuchko *et al.*, 2019).

Thanks to the MMN it was discovered that the human brain is more efficient in discriminating frequency changes between sounds if the sound spectrum is complex. In particular, Tervaniemi *et al.* (1993) have discovered that the MMN amplitude to the same amount of frequency changes increases, and the latency is reduced while using piano sounds compared to simple (sinusoidal) tones. Along the same line, Tervaniemi *et al.* (1997) have demonstrated how pitch changes were detected more accurately and evoked a larger MMN with a shorter latency when sounds had a richer spectrum than with sinusoidal tones. Hari *et al.* (1992) compared MMNm (that is the magnetic equivalent of the electric MMN) in response to frequency changes of isolated sinusoidal tones with that to changes within paired tones, discovering a stronger MMNm in the latter case. According to the authors, these results demonstrate that the strength of memory traces depends on the complexity of the stimuli.

MMN can be generated by two distinct mechanisms: the first is called "passive sensory adaptation" or "neuronal refractoriness" to individual tones and occurs after prolonged exposure to repetition of stimuli or sound features (Brattico *et al.*, 2003). The second one is the «predictive coding based on the probability of transition between tones» (Dehaene *et al.*, 2015). Therefore, from the studies listed above it emerged that brain anticipates better the errors in the case of complex sounds, but it was also seen how this ability is more evident in musicians than in nonmusicians (Brattico *et al.*, 2009; Koelsch, Schröger & Tervaniemi, 1999; Vuust *et al.*, 2012). In a similar way, Brattico *et al.* (2001) reported a shorter left-lateralized MMN latency to familiar tone patterns than unfamiliar ones, suggesting that musicians have faster neural mechanisms in the left hemisphere to process pitch pattern changes, probably thanks to daily musical training with

that type of sound material. Further studies have been then conducted: Tervaniemi, Huotilainen & Brattico (2014) found that when folk musicians were compared to non-musicians, the MMN was larger for mistuned sounds, possibly as a consequence to the central role of melody and pitch in Finnish folk music. Furthermore, Quiroga-Martinez *et al.* (2019) discovered that high-entropy stimuli, consisting of a set of non-repetitive melodies, had lower MMNm amplitudes for pitch and slide deviants than low-entropy (LE) stimuli, consisting of a simple, repetitive pitch pattern. These findings are consistent with predictive coding theories (Clark, 2013; Feldman & Friston, 2010; Hohwy, 2012) and models of musical expectations (Hansen, Dietz & Vuust, 2017; Ross & Hansen, 2016; Vuust *et al.*, 2018) which propose that prediction error responses are reduced in contexts with low as compared to high predictive precision. This study confirms that precision of auditory (musical) models affect prediction error while listening.

In sum, MMN studies demonstrated neural mechanisms for sensory predictions of music in the short-term, as affected also by long-term experience and second-order predictions, helping us to understand how the human brain processes auditory information from the environment.

Working memory for music and its neural correlates

Few recent fMRI studies using verbal and non-verbal auditory stimuli have revealed that WM for sounds activates areas such as the frontotemporal gyrus, the supramarginal regions and the cerebellum (Gaab *et al.*, 2003). An fMRI study by Schulze *et al.* (2011) investigated the neuroanatomical correlates of verbal and musical WM in relation to music training and found that WM-related neural structures namely the Broca's area, motor and premotor areas, the left insular cortex and the inferior parietal lobe, were activated for both verbal and tonal n-back tasks, with no significant differences between musicians and non-musicians. Furthermore, specific areas were activated in the musicians' brains either only during verbal n-back tasks (right insular cortex) or only during tonal n-back tasks (right globus pallidus, right caudate nucleus and left cerebellar hemisphere). These findings suggest the existence of two WM systems in musicians: a phonological loop and a tonal loop (Schulze *et al.*, 2011).

Pallesen *et al.* (2010) measured the metabolic activity of the brain (blood-oxygen level dependent or BOLD signal) in musicians and nonmusicians during an n-back task with musical chords transposed over several octaves in order to determine the relationship among performance, musical proficiency, and overall enhanced cognition. From this study it emerged that musicians had a better performance in WM tasks than nonmusicians, and as WM load increased, musicians demonstrated higher increases in BOLD brain responses than non-musicians, replicating the well-known association between WM load and task performance (Baddeley, 1986; Just & Carpenter, 1992; Sternberg, 1969). The study also suggests that superior WM task performance in musicians rely on an enhanced ability to exert sustained cognitive control, which may be a consequence of focused musical training. Furthermore, Salmi *et al.* (2010), using the same dataset as Pallesen *et al.* (2010) demonstrated that this load increase in a musical WM task is associated with enhanced brain activity in the parietal, dorsal premotor, and lateral prefrontal cortices as well as lobules VII–VIII of the posterior cerebellum, while on the contrary the 0-back sensory-motor task activated the motor/somatosensory, medial prefrontal, and posterior cingulate cortices and lobules V/ VI of the anterior cerebellum, suggesting that the posterior cerebellar activation during a demanding cognitive task is involved with optimization of the response speed.

In the studies mentioned above, WM was studied using controlled button-press tasks with simple musical stimuli, that likely generate mental states that are different from those emerging from real-life listening situations. To overcome this limitation, Burunat *et al.* introduced the naturalistic paradigm in musical memory studies by means of fMRI (Burunat *et al.*, 2014). Two different experiments were conducted within the same study. A first experiment was a listening test with musicians and amateurs and the piece "Adios Nonino" by Astor Piazzolla. This experiment was functional to identify segments of the piece that were used as regressors for the analysis of an fMRI experiment, in which a separate group of musicians listened freely and attentively to the same musical piece without any interruptions. The statistical maps of the t-tests between the repetition of the motifs and their first presentations showed activations of brain regions related to WM for the musical motifs: hippocampus, basal ganglia, dorsolateral prefrontal cortex (PFC) and cerebellum (Figure 1). These results not only

replicated previous studies on musical WM where artificial sequences or isolated chord cadences were presented to the participants but highlighted the role of the hippocampus, never clearly found in a musical memory neuroimaging experiment. No activations of the supratemporal auditory regions emerged since sensory coding processes were excluded from the main analyses by using covariates.

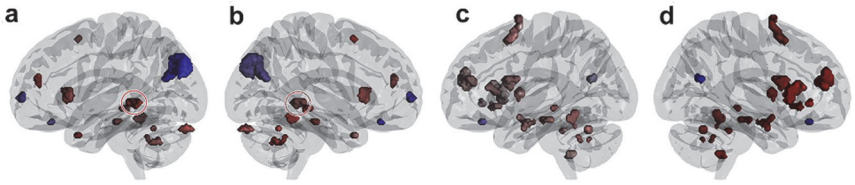

Figure 1. Left and right lateral ([a] [d]) and mid-sagittal ([b] [c]) views of the thresholded statistical map displaying positive (red) and negative (blue) correlations with the WM regressor. The hippocampal activation is indicated in the left hemisphere. Figure reproduced with permission by Burunat *et al.* (2014). Dynamics of brain activity underlying working memory for music in a naturalistic condition. *Cortex*, 57, 254-269. Copyright Elsevier.

Further studies using the naturalistic free-listening paradigm were conducted also with MEG and EEG methods. These studies were aimed at extracting transient evoked cortical responses to musical features during realistic listening. Haumann *et al.* (2021) discovered that naturalistic P1/N1/P2 transient evoked cortical responses (ERs) can be extracted with high reliability at sound onsets in real musical pieces, and that naturalistic P2 responses are localized to core cortical regions of the auditory cortex. P1/P2 responses were shown to be predominant in monophonic/homophonic passages of the music (piano solos), whereas N1 responses were only detectable in the polyphonic parts with the whole orchestration. The authors observed that the P2 responses were evoked by increases in the acoustic features of intensity and spectral flux, which are commonly used to locate the onset times of syllables in speech and the onsets of tones in musical pieces (Alías *et al.*, 2016). This result can be interpreted according to many theories, such as predictive coding but also superposition, refractoriness or habituation (Heilbron & Chait, 2018). Predictive coding theory may explain the lack of measurable early brain responses to repeated stimuli (Bendixen, Schröger, & Winkler, 2009; Brattico, Bogert & Jacobsen,

2013; Herrmann *et al.*, 2015; Todorovic *et al.*, 2011; Vuust *et al.*, 2009; Winkler, Denham & Nelken, 2009), as well as the hypothesis of stimulus-specific habituation and dishabituation (Butler, 1968, 1972a, 1972b; Fruhstorfer, Soveri & Järvilehto, 1970; Graham, 1973; Gu *et al.*, 2018; Loveless, 1983; Megela & Teyler, 1979; Näätänen & Picton, 1987; Näätänen *et al.*, 1988; Öhman & Lader, 1977; Picton *et al.*, 1978; Thompson & Spencer, 1966; Thompson & Groves, 1973; Woods & Elmasian, 1986). The superposition hypothesis focuses on overlapping cortical responses in M/EEG waveforms, which are commonly observed in fast rate events (Simon, Balla, & Winkler, 2019; Tan *et al.*, 2015), so the sum of the overlapping response waveforms will result in cancellation or summation between the overlapping positive and negative evoked potentials or fields. The observed lower (or higher) response amplitudes might be accounted for by this destructive (or constructive) interference. However, it has been noticed that the superposition hypothesis is insufficient for characterizing additional amplitude changes across inter-onset intervals stimuli (IOI) in studies where fast steady-state responses (SSR, with periodic stimulation greater than 1 Hz) have been simulated by increasing the rate of overlapping cortical ERs (P1/N1/P2) (Tan *et al.*, 2015). SSR phenomenon supports the theory of "stimulus-specific entrainment" posing that the spontaneous cortical oscillations of neuronal assemblies lock to the environmental stimuli modulating power of oscillations according to the exogenous frequencies (e.g., Brenner *et al.*, 2009).

A further explanation of cortical memory processes is represented by the cortical refractoriness theory, stating that over a ten-second recovery time, a group of stimulated cortical neurons reacting to a stimulus becomes less receptive (Brattico *et al.*, 2003; Zacharias, König, & Heil, 2012). This "passive adaptation effect", also known as "neural fatigue", is thought to be a mechanism that "boosts sensory systems" processing efficiency (Grill-Spector, Henson, & Martin, 2006). The excitability of cortical neurons is progressively restored throughout this recovery phase. The auditory cortex neurons have a shorter time to fully recover their excitability when the sound elements of interest are presented with shorter IOIs. As a result, cortical excitability would be reduced, as would the amplitudes of cortical ERs. Nonetheless, the cortical refractoriness theory has been questioned by new findings indicating the role of expectancies (or "predictions") (Costa-Faidella *et*

al., 2011; Euler & Ricci, 1958; Pearce *et al.*, 2010; Serkov, Leonova & Shelest, 1969; Todorovic *et al.*, 2011).

Long term musical memory and its neural correlates

Numerous studies have tried to investigate musical LTM in Alzheimer's disease (AD), a type of dementia that primarily affects memory, thinking and behavior, to evaluate residual abilities. For instance, Lola Cuddy's studies suggest that some sort of LTM for music is preserved in most cases of AD patients (Vanstone & Cuddy, 2009). Further studies have made it possible to advance the hypothesis that explicit musical memory is impaired in most AD cases, supporting the notion that the brain regions most affected since the early AD stages – particularly the frontal lobe – mediate this kind of memory. What seems to be preserved is implicit memory, which in musicians corresponds to the procedural memory of playing an instrument, suggesting how AD does not fully compromise these brain functions and supporting the distinction between explicit and implicit musical memory (Baird & Samson, 2009). Moreover, music has been demonstrated to facilitate autobiographical memories in AD patients (Peck *et al.*, 2016). In particular, Irish and colleagues (2006) discovered that total autobiographical recall was considerably better in the music than in the silent condition when comparing the influence of background music against a silent testing condition on autobiographical memory in people with moderate Alzheimer's disease. Furthermore, García *et al.* (2012) presented samples from several kinds of music, including joyful music, sad music, new music, and industrial noise, to see if the observed benefits in autobiographical memory in AD patients are music-specific. When compared to all other conditions, autobiographical memory was considerably improved when exposed to sad music, but only for recall of remote memories and not for recent memories. The authors propose that it is not the music itself that enhances remote autobiographical memory recall, but rather the emotion that goes along with it, and that the ability of music to specifically promote recall of distant rather than recent autobiographical memories may be significant in restoring a sense of identity. These findings have then been confirmed by another study by Cuddy *et al.* (2017), showing that the

presence of song lyrics or even favorite music is not required to elicit autobiographical memories; rather, "pure" instrumental music that is widely known in the culture is sufficient. Regardless of this, listening to favorite music elicits a specific activation of the supplementary motor area, which has been linked to memory for familiar music and is often spared in early AD (King *et al.*, 2019). Following the presentation of preferred musical stimuli, King and colleagues discovered widespread increases in functional connectivity in corticocortical and corticocerebellar networks, indicating a transient impact on brain function and supporting a mechanism through which attentional network activation in the brain's salience network improves brain network synchronization.

Another study by Johnson *et al.* (2011) propose to compare music recognition in a clinical population with various types of dementia (i.e., AD, frontotemporal and semantic dementia), and results have shown how patients with semantic dementia had considerable difficulty naming familiar melodies and also scored the lowest when asked to identify pitch errors in the same melodies, suggesting that naming familiar melodies is strongly related to measures of semantic memory. After that, voxel-based morphometry analysis of AD brains revealed that an impairment in naming songs was linked to the bilateral temporal lobes and inferior frontal gyrus, whereas difficulty detecting pitch errors in familiar melodies was linked to alterations in the right temporal lobe. These findings suggest that the anterior temporal lobes are involved in the memory system for melodies, and that musical functions are impacted differently in different types of dementia.

More recently, further studies have been conducted to better investigate the role of different areas for the recognition of complex musical patterns: for this purpose, Bonetti *et al.* (2021b) combined MEG and MRI, discovering a dual processing brain mechanism. The single tones forming the patterns were independently elaborated by a rapid, oscillatory, local processing driven by the auditory cortex. The combination of those single tones into a meaningful superordinate pattern, instead, seems to depend on a simultaneous global, slow processing that also involves a widespread network of sequentially active high-order brain areas largely related to audition, memory, attention and decision-making, i.e., the hippocampus, cingulate gyrus, inferior temporal cortex, frontal operculum, insula (Bonetti *et al.*, 2021b).

In another MEG study (Fernández-Rubio *et al.*, 2022), 71 participants first listened for a few times to a prelude in C major by J. S. Bach as well as to an acoustically and structurally matched atonal piece and then had to recognize if 5-tones patterns were previously heard or not (old/new task). Results showed that the superior behavioral recognition for tonal patterns that were previously heard and memorized was supported by memory-related brain areas such as the left hippocampus and cingulate. In turn, the worse recognition of atonal patterns activated only an auditory temporal network. Due to its binding function, the hippocampus involved in recognition memory for tonal sounds might be related to a wide range of situations involving auditory information, such as integrating acoustic features into a perceptual whole, anticipating the continuation of sound sequences, and "mental navigation" along sequences of auditory stimuli (Billig *et al.*, 2022).

From locationism to the static connectome

In the search for the neural basis of memory, studies in the field of neuropsychology, with brain-damaged patients, and neuroimaging, with fMRI, have allowed to isolate the contribution of each brain region, albeit at a low temporal resolution, since the fMRI signal summarizes the BOLD signal over the course of a few seconds. A better temporal resolution useful to studying the unfolding of auditory memory traces following one another at a very fast rate can be obtained with neurophysiological techniques such as EEG and MEG. Although these techniques have a very detailed temporal resolution, at a spatial level the source reconstruction of the neural sources originating the MEG/EEG responses to sounds are typically limited to regional activity, and specifically often only to the bilateral auditory cortex. Hence, these studies can be described as "locationists" for their intent to map memory functions in specific structures of the central nervous system. In the last decade, the locationism approach has been complemented by a novel, dynamic approach that shows the synchronous interaction of various brain structures for the formation and codification of sound memories, as will be illustrated later. However, the analysis of single brain regions provides an incomplete picture of brain functions and mechanisms.

The latest viewpoint balances integration and segregation, conceiving the relation between structure and function as based on dynamic communication among brain areas, hence emphasizing the need for imaging the fiber tracts and for computing correlations between neural responses from different locations of the brain in, respectively, structural or functional connectivity (FC) studies (Sporns, 2012). Structural connectivity among brain regions seeks physical connection networks in the brain. In turn, static FC highlights activation similarities between brain regions regardless of the anatomical connections between them.

According to the FC approach, the interactions between circuits and regions of the brain are examined, quantifying whether the fluctuations in neuronal activity originating from each region are correlated over time. The frequencies at which these fluctuations have the greatest power during WM tasks are between 4 and 8 Hz, especially in the hippocampus and prefrontal regions (Tesche & Karhu, 2000). In the study by Burunat *et al.* (2014), a PPI (Psychophysiological Interactions) analysis was conducted, revealing not only the modulatory effects of WM on FC patterns, but also how most of the areas relevant to WM (left hippocampus, putamen right, right caudate nucleus and right frontal gyrus) seem to function independently during WM tasks, possessing intrinsic FC related to listening to motifs that has been already presented. Neural connections related to musical memory have been measured even in the brain of babies in two recent studies (Lordier *et al.*, 2019; Loukas *et al.*, 2022). By comparing the resting brain activity of infants who had listened to familiar music for ten minutes a day, for several weeks, an intrinsic static FC was found between regions of the auditory cortex, and then between orbitofrontal cortex and motor regions, as well as between amygdala and thalamus in the right hemisphere, therefore, between areas linked to the encoding of emotional memories.

From static to dynamic connectivity: the temporal evolution of brain memory networks

Advanced analytical methods can measure the "effective connectivity", which quantifies the causal influence of one area over another, as

well as how connectivity varies based on task variables (Buckner, Krienen & Yeo, 2013; Fornito & Bullmore, 2012). In a study conducted by Lumaca *et al.* (2021), for example, effective connectivity was measured during the learning of complex tone patterns using dynamic causal modeling on fMRI data. The results of the study showed a decrease in inhibitory connectivity within left Heschl's gyrus and an increase in feedforward connectivity from the left Heschl's gyrus to planum temporale during the presentation of deviant stimuli, suggesting that complex auditory prediction errors are encoded by changes in feedforward and intrinsic connections, confined to the superior temporal gyrus).

Effective connectivity as well as static FC, however, provide only a snapshot of the brain processes related to a task. When a task evolves over time, as in the case of music, it becomes necessary to adopt a dynamic approach, which allows the evaluation of the passage of information through the various neural systems, from coding to retention and recovery, in a dynamic process that develops temporally.

In the last few years, a totally new approach called "dynamic connectome" has emerged. This approach derives from the observation made by scientists who have found how the FC networks changed significantly according to the brain state of the participants, such as sleep, mental tasks and learning, and even during the course of the same experimental session, correlating with the behavior (for a review, cfr. Leopold & Maier, 2012). Thanks to the work of scientists like Olaf Sporns, Danielle Bassett, Edward Bullmore, Gustavo Deco and Morten Kringelbach, methods of physics of complex networks have been introduced in cognitive neuroscience to analyze changes in the FC, giving rise to the new approach called «dynamic functional connectivity» (DFC).

By DFC we refer to the phenomenon according to which FC changes in a short period, and it is a recent expansion of traditional FC analysis which generally assumes that functional networks are static over time (Allen *et al.*, 2014; Calhoun *et al.*, 2014; Hutchison *et al.*, 2013; Sakoğlu *et al.*, 2010). It has recently been suggested that DFC is a more accurate representation of functional brain networks, which evidences in a better way neurological and psychiatric disorders than static FC (Zhao *et al.*, 2020). The main instrument to measure DFC is the fMRI. Nevertheless, fMRI measures metabolic changes of the BOLD signal in a very different time scale compared to the

electrophysiological measurements of neural synchrony obtained on animal models, or with EEG or ECoG (electrocorticography) on humans. Therefore, due to the slow time course of the BOLD signal, the FC resulting from fMRI can only quantify the correlations that occur at frequencies below 0.1 Hz (Fox & Raichle, 2007), allowing to partially highlight the temporal development of a complex dynamic process such as that related to auditory memory. On the other hand, electrophysiological recordings typically measure synchrony at frequencies between 1 and 100 Hz, and for this reason DFC studies on the MEG signal have been published in recent years (Bonetti *et al.*, 2020; Bonetti *et al.*, 2021c; Bruzzone *et al.*, 2022).

To obtain DFC from signals that are fMRI or MEG, the "correlation-based sliding window" analysis is usually used (for a review, cfr. Preti *et al.*, 2017), which was introduced for the first time by Sakoğlu *et al.* (2010) in a schizophrenia study. This approach consists in correlating fMRI signals between distinct brain regions with a predefined number of time points that form a "window". This defined window is then moved a certain number of scans forward in time and then an additional analysis is performed, which reflects the presumed temporal changes associated with the spontaneous activity of brain networks. Another and more recent approach is Instantaneous Phase Synchrony (IPS; Omidvarnia *et al.*, 2016), which compares the phase angles for each voxel or brain region (depending on the area of interest) at each individual time point, thus providing the same temporal resolution as the original fMRI data.

For the first time, the dynamics of the formation of memory traces and of the recognition of musical sounds through DFC have been studied during the recall of sound patterns learned during the experimental session (Bonetti *et al.*, 2020). The sample of 70 participants, made up of musicians and non-musicians, was required to listen carefully for 10 minutes of the Prelude in C minor BWV 847 by J. S. Bach. During a subsequent MEG measurement, an excerpt from the Prelude they had previously listened to, or a new variation pattern also by Bach, were presented to the participants. Aim of the study was to find the brain sources of the differences between the condition in which the Bach pattern was recognized and the conditions in which the new variation occurred, by calculating the dynamic brain connectivity between all neocortical regions. From DFC analysis, it emerged that the

hippocampus, the cingulate gyrus and the PFC are more connected to the rest of the brain when the incoming stimuli correspond to the prediction (Bach original), while the auditory cortex appears more central (mainly connected with the motor cortex and dorsolateral PFC) to indicate the violation compared to prediction (while listening to the Bach variation).

Hence, the novel DFC approach adopted in the study by Bonetti *et al.* (2020) allowed to examine not only the previously-observed hippocampal and frontal involvement in musical memory but also the involvement of brain structures such as the insula, frontal operculum and basal ganglia, which play a role both in the classification of salience of the stimuli and in the detection of prediction errors during listening (Cauda *et al.*, 2011; Limongi *et al.*, 2013; Uddin, 2015).

Conclusion

To summarize, we argue that the recent technical developments allow us to move away from a locationist approach towards understanding the dynamic organization of the fast-changing connections between brain areas during the various memory stages: from encoding to consolidation and recall. As Bassett and colelagues pointed out (2011), learning and memory require "rapid adaptation to an ever-changing environment". Only neuroimaging methods that consider the dynamics of brain activity and connectivity will be effective in describing learning and memory in relation to an ever-changing, complex environmental stimulus such as music.

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Covid-19 representations in Italian newspapers: A text-based analysis

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Abstract

The paper presents the results of an analysis aimed at mapping the themes through which covid-19 is represented in some Italian newspapers and the semantic structure that grounds and shapes the content of those themes. For this purpose, the ACASM (Automated Co-occurrence Analysis for Semantic

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Mapping) procedure was used and applied to a text corpus consisting of a set of national newspaper articles balanced by source, political orientation and publication period. The results show that Italian newspapers represented the pandemic according to four specific themes based on two semantic structures. The implications of these results are discussed.

Keywords: representations of covid-19, frame, theme, text analysis, ACASM.

Introduction

The media played a central role in informing the public during the spread of covid-19 (Sowden *et al.*, 2021), since its first detection in late December 2019 in the city of Wuhan in China (Chen *et al.*, 2020). Covid-19 has been the most discussed disease in human history (Tsoy *et al.*, 2021) and the pandemic has been labelled as "infodemic" due to exceptional media coverage (World Health Organization, 2020). It is now recognised that the media plays a key role in providing lenses that shape personal experiences and attitudes (Sowden *et al.*, 2021), reflecting and reinforcing cultural conventions along with the sense-making process (Weaver & Jackson, 2012) and playing an important role in the construction of risk perceptions in the population due to the large availability of data (Chong & Choy, 2018). The media act as a repository of resources for understanding and everyday practices, as they represent a tool for the social construction of shared beliefs, feelings and worldviews – due to their specific functioning and their specific language (Mazzara *et al.*, 2021).

In the context of the covid-19 pandemic, the amount of data and interpretations given to the population allowed mass media to promote implicit or explicit interpretative frames about the health emergency (Crabu *et al.*, 2021) and that is why the representation of covid-19 shaped by the media has important societal implications. Therefore, newspaper articles represent a powerful resource for the understanding of how societies conceive the origin of an outbreak (Crabu *et al.*, 2021). To date, many newspaper articles have been analysed using different approaches. Some authors used van Dijk's critical discourse analysis (CDA; 2005) to identify the representations, discourse

structures, and strategies used in representing covid-19. For example, Chaiuk and Dunaievska (2020) found that editorials, headlines, and newspaper articles emphasised the global nature of the pandemic and the inadequacy of government measures to contain the disease; Osisanwo (2022) underlined ten strategies of representation (e.g., economic cancer, a threat to human beings, common enemy), six discursive strategies (e.g., demonising, criminalising, condemning) and twelve ideological discursive structures (e.g., description of the actor, authority, burden) and different participant representations and roles (e.g., solver, potential super spreader). Dezhkameh and colleagues (2021), through van Dijk's (2009) ideological square framework, investigated the ideological differences in reporting the news related to the pandemic, showing that evidentiality, hyperbole, metaphor, national self-glorification, negative lexicalisation, and numbers game were the most frequent micro-strategies used to manipulate readers' minds. Using a corpus-driven analysis of news about covid-19 in a Malaysian online newspaper, Mohd Nor and Zulcafli (2020) pointed out that the latter reflected fear, anxiety, and uncertainty just like the majority of Malaysians and portrayed the government to be in total control of the situation, despite the threat to health and economic situation of the country.

Another perspective used in the study of media discourse is that of the framing theory. Framing refers to the process by which people develop a particular conceptualisation of a matter or reorient their thinking about a matter (Chong & Druckman, 2007). As stated by Entman (1993), «To frame is to select some aspects of a perceived reality and make them more salient in a communicating context, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation for the item described» (p. 52).

More specifically, in communication studies the concept of frame is used for its ability to explain the connection between the content of the message and the psychological mechanisms involved in the influence of the media (Mazzara *et al.*, 2021). In fact, it has already been used in different fields, such as climate change (e.g., Anshelm & Hultman, 2014; Knight & Greenberg, 2011; Stecula & Merkley, 2019), public opinion (e.g., Fine, 1992; Lecheler & de Vreese, 2012), economy (e.g., Martin, 2016), so it can also be adopted to analyse the role played by the media in shaping public opinion about covid-19.

Researchers found different frames of covid-19 conveyed by the media in different countries: while some media shaped representations of the disease in terms of darkness, hope, precaution and frustration in different proportions (Ogbodo *et al.*, 2020), others distinguished a scientific frame focused on symptoms and health effects, a containment frame focused on attempts to lessen risks, and a social frame focused on political and social impact (Ophir *et al.*, 2021). Poirier and colleagues (2020) found that Canadian media covered the crisis extensively; specifically, the francophone media framed the pandemic more as a health and economic emergency, while the anglophone media more frequently used the frames of the Chinese epidemic and the social impact of the pandemic. Rodelo's (2021) study of Mexican newspapers found that attribution of responsibility, human interest and political actions were the main frames conveyed by newspapers to interpret the reality of the covid-19 pandemic while, at the same time, scientific information and self-efficacy were left in the background. After analysing nine-week reports from one of China's leading media outlets, Gui (2021) found a dominant frame related to war, which, however, did not remain constant. In fact, some semantic concepts, such as the type of war, have evolved over time. The author also observed the presence of several minor frames, such as racing, challenge, chess and the "combination blow", which, however, were not as dominant as the war-related frame. Racing refers to the need to take fast actions; challenge refers to people's need to strive in order to fight the pandemic; chess and combination blow refer to the fact that a wrong move/blow can lead to failure in dealing with the pandemic. Such frames, however, were not as dominant as the war-related frame.

These works have a common feature: they focus on frames by understanding them as specific and contingent meanings attributed to the phenomenon studied (in this case covid-19). However, such a focus does not allow to highlight the structure of cultural generalized meanings grounding such specific and contingent meanings. Therefore, this paper aims to overcome this constraint by investigating, on the one hand, the frames conveyed by the media within the Italian context; on the other hand, by identifying the generalized cultural meanings that organize such frames. For this purpose, the perspective of the Semiotic Cultural Psychology Theory (SCPT; Salvatore, 2016; Valsiner, 2007) is adopted. The SCPT conceives frames as a stable pattern of meaning

that makes some features/qualities of the represented topic (e.g., covid-19) pertinent and leaves others in the background. In other words, frames do not consist of specific and circumscribed meanings attributed to covid-19 (e.g., "covid-19 contagion has decreased in the last period"; "the incidence of mental illness caused by covid-19 is X%") and/or statements about discrete events and facts that may be associated with this phenomenon. Rather, a frame is a pattern of meanings that functions as a semantic context that shapes the interpretation of meaning of the discrete representative elements associated with it. Frames, in turn, are based on the semantic structures that organize them, which represent the basic components through which a given object is represented (Rochira *et al.*, 2020; see next section).

Framework

According to SCPT, a certain topic is represented according to a stable pattern of meaning that foreground a subset of characteristics/qualities, thus leaving others in the background. Such a pattern of meaning can be modelled in terms of thematic nucleus (henceforth: theme[s]) that make certain links between qualities of the topic relevant. In this way, each theme performs a double framing role: on the one hand, it extracts the relevant reality from the possible worlds; on the other hand, it provides a semantic map of the relevant reality extracted, channelling the audience's way of feeling, thinking, and thus acting. It is worth noting that a theme is a network of meanings related to each other, rather than a specific semantic content associated with a single quality. Consequently, the meanings that make up the theme acquire significance because of their position within the network: for example, in the context of the theme/frame "identity," cultural differences could be interpreted as a challenge to group stability; while in the context of the theme/frame "innovation", cultural difference could be interpreted as a source of development. The themes are in turn grounded and shaped by an underpinning semantic structure. The semantic structure can be modelled as a set of basic semantic components: each semantic component maps a quality of the object represented- a theme consists of the presence or absence of the qualities that the semantic components make relevant (Salvatore *et al.*, 2012). More specifically, each semantic component

takes the form of a dichotomy whose poles are characterised by two oppositional meanings connected with each other in a dialectical relationship. In any given context and at a given moment, one pole is made salient while the other is neutralised (Rochira *et al.*, 2020). For example, take the semantic component |good|: to represent something as good is ipso facto to affirm that it is not bad.

Aims

The media representation analysis is designed to map the themes in terms of which the media frame the meaning of covid-19 and the semantic structure that grounds and shapes the content of such themes. Specifically, this study aims to: (a) identify the themes that emerge from media discourses on covid-19; (b) identify the basic semantic structure underpinning the themes; (c) examine whether and to what extent the semantic structure are or are not similar over time and across the spectrum of media political orientations. These objectives are important on a theoretical and practical level. On a theoretical level, they represent a contribution to the empirical analysis of the challenging issue of the relationship between the outputs (i.e., the contents) and organisational principles (i.e., the semantic structures) of social meaning-making processes (Salvatore & Venuleo, 2013). On a practical level, the benefit of the analysis of the relationship between the media's political orientation and the semantic structure is that it allows to understand if differences between political orientation of the newspapers are an expression of – and fuelled by – deep distances at the level of semantic structure or are a variation within the same semantic structure.

Method

Data source

Analyses were performed on the textual corpus consisting of a set of articles of national newspapers balanced for the political orientation of the source (center/left vs. center/right-wing) and period (18 time units were defined, each corresponding to a week). The sample was

built by means of the following procedure. First, a set of keywords (coronavirus, covid, epidem*, pandem*) being able to detect articles addressing the covid-19 as main topic were identified. This was carried out by means of a series of preliminary frequency analyses on a pre-selected set of articles that independent raters had considered focused on covid-19. Second, the keywords thus identified were applied to the whole dataset of articles published from January to May 2020 on a group of 9 Italian national newspapers (*Repubblica*, *Il Manifesto*, *La Nazione*, *L'Avvenire*, *Corriere della Sera*, *Italia Oggi*, *Libero*, *Il Sole 24 Ore*, *Lettera 43*). These sources were based on two criteria: (a) they provide a broad enough coverage of the spectrum of cultural and political orientation of the Italian press; (b) they provide an easy access to the digital format of articles. Finally, for each newspaper x week block of the sample, 15 articles were randomly selected from the whole universe of articles obtained from the previous step. Thus, the sampled textual corpus consisted of 1700 articles (it must be noted that in the case of some blocks, the expected number of articles was not reached). Table 1 shows the distribution of the articles per week and newspaper.

Table 1. Distribution of the selected articles per time block and type of newspaper (C/L = center/left wing political orientation, C/R = center/right wing, C = centre).

		Time blocks																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
		01-05 Jan	06-12 Jan	13-19 Jan	20-16 Jan	27-02 Jan/Feb	03-09 Feb	10-16 Feb	17-23 Feb	24-01 Feb/Mar	02-08 Mar	09-15 Mar	16-22 Mar	23-29 Mar	30-05 Mar/Apr	06-12 Apr	13-19 Apr	20-26 Apr	27-03 Apr/May	
Newspapers		Number of articles																		Total
Repubblica	C/L	0	3	4	15	14	15	15	13	12	15	12	15	15	15	15	15	15	15	223
Il Manifesto	C/L	0	0	0	3	9	9	10	8	15	15	15	15	15	15	15	15	29	9	197
La Nazione	C/R	0	0	0	15	15	15	15	13	15	15	15	15	15	15	15	15	15	15	223
L'Avvenire	C	0	0	0	10	8	15	14	15	15	15	14	15	15	15	13	15	15	15	209
Corriere della Sera	C	0	0	2	15	15	15	15	15	15	15	14	15	15	15	15	15	15	15	226
Italia Oggi	C	0	0	0	3	7	9	11	4	14	15	15	15	14	15	14	15	15	15	181
Libero	C/R	0	1	0	0	0	0	1	0	5	1	6	5	8	6	6	1	11	13	64
Il Sole 24 Ore	C	4	0	1	6	13	14	14	12	11	14	13	11	15	14	15	14	15	15	201
Lettera 43	C/L	0	0	0	0	0	0	0	12	15	15	15	15	15	15	15	15	29	15	176
																				1700

Data analysis

Data analysis was carried out by means of the Automated Co-occurrence Analysis for Semantic Mapping procedure (ACASM, Salvatore *et al.*, 2012; see also Buhagiar *et al.*, 2020). ACASM is based on a semiotic view of meaning (Valsiner & Rosa, 2007) seen in terms of sign transition. In the case of texts, sign transition takes the form of co-occurrences between lexemes (namely, syntagmatic associations) within the same contextual units (e.g., a paragraph of the text). The ACASM procedure was implemented by using the T-Lab software (Lancia, 2004) through the following operative procedure.

Construction of the Digital Corpus

This procedure constructs a matrix consisting of text segments in rows and lemmas in columns. Each ij-th cell contains information about the presence (1) or absence (0) of the j-th lemma within the i-th segment. The construction of the digital matrix involves, in turn, three additional operations necessary for multidimensional analysis:

Segmentation

The corpus is divided into units of analysis each of which represents an elementary context unit (ECU). An ECU consists of a group of a few contiguous utterances. The division of the text into ECUs must find a balance between two requirements: on the one hand, the segments must be long enough to be interpretable in terms of thematic content; on the other hand, the longer the segments, the greater the likelihood that each segment is not associated with a specific thematic content. Consequently, the paragraph was chosen as parameter to segment the corpus. The T-Lab's automated segmentation algorithm adopts the following criterion to segments the text in paragraph: (a) each ECU begins with the character immediately following the last character of the preceding ECU; (b) each ECU ends with the first punctuation mark (".", or "!", or "?") and with the return key; (c) the length of the ECU must not exceed 2000 characters; therefore, the

ECU ends in every case with the last word that remains within this limit, even in the absence of a punctuation mark.

Lemmatization

The lemmatization is aimed at reducing the lexical variability in the corpus, as multidimensional analysis requires a reduction in the dispersion of the data matrix. First, all lexical forms in the text are collected (a lexical form is a string of characters between two blanks; thus, in most cases a lexical form corresponds to a word, especially in the case of written texts). Second, each lexical form is categorized according to the lemma to which it belongs. A lemma is the citation form (i.e., the headword) used in the language dictionary to refer to a lexeme (i.e., a set of word forms that have the same lexical root and meaning). For example, word forms such as "play", "playing" and "played" have "play" as their lemma; "man" and "men" have "man" as their lemma. The lemmatization of the corpora was performed using the vocabulary provided by T-Lab. The output of this procedure is the list of lemmas present in the text corpus.

Selection of lemmas

The list of lemmas resulting from the previous step was subjected to selection in order to exclude lemmas not useful for the analysis. Specifically, we excluded: (a) stop-words, instrumental, empty and indicative words (e.g., "namely", "indeed", "and", "this"), namely, words without specific semantic content (the exclusion of these words was carried out through the automatic application of T-Lab's stop-words list with a following refinement check made by the research team); (b) basic auxiliary verbs (i.e., to be and to have); (c) the 5 lemmas with the highest frequency (this is because the more frequent the lemma, the less it helps to detect specific semiotic patterns – i.e., the more it acts as noise only). After applying these criteria, the 1000 most frequent lemmas were selected. This number of lemmas represents a balance between two conflicting needs: on the one hand, to keep the analysis within the computational constrain of the algorithm; on the

other hand, to get a large enough extension of the analysis, in order to enable the detection of meaningful patterns from data.

Multidimensional analysis

The digitalized matrix resulted from the previous step (see "Construction of the Digital Corpus" sub-section) was subjected to a multidimensional procedure of data analysis aimed at mapping the patterns of co-occurring lexemes that characterize the corpus. This procedure consists of the combination of Cluster Analysis (CA) and Correspondence Analysis (COR) applied to the CA's output. To be more specific:

Cluster Analysis

CA was performed on the digital matrix ECU * Lemmas aimed at grouping the ECUs of the textual corpus into clusters.CA is designed to extrapolate clusters of lexemes that tend to co-occur within the same text segments. Each cluster aggregates a set of segments (i.e., paragraphs) that tend to be similar to each other because they are made up of similar lexemes. It follows that each cluster of co-occurring lexemes (and the segments in which co-occurrence happens) can be interpreted as the marker of a specific semantic content – i.e., a theme. In other words, co-occurrence of words is taken as a similarity criterion for clustering text units: text units that contain the same co-occurring words are considered similar and are therefore clustered. The rationale is that a set of co-occurring words distinguishes a specific theme. Therefore, text units that share a certain set of co-occurring words share the thematic content marked by that set. In this way, the content analysis procedure is able to provide a fine level of semantic representation by coding each text unit of analysis in terms of a specific content, which in turn is marked by the set of co-occurring words according to which the unit was clustered.

Correspondence Analysis

Afterwards, a Correspondence Analysis (COR) procedure was applied on the obtained matrix having lemmas as rows, and clusters as columns, with each ij-th cell indicating the frequency of the i-th lemma within the j-th Cluster. COR aims to identify the semantic structures underlying the themes emerged from the CA. This procedure decomposes and reorganizes the relationships between lexemes in terms of a multidimensional structure of opposing factorial polarities, where each polarity is characterized by a set of signs that tend to co-occur and do not occur in the case of occurrence of an opposite set. In addition, COR allows further variables to be represented on the factorial dimensions extracted from the data matrix. Such variables are called illustrative, because they do not contribute to the definition of the multidimensional space but are associated with the factorial dimensions once defined. Consequently, it is possible to evaluate the relationship of the semantic structures with the characteristics of the segments and articles (in our case, the time block and the political orientation of newspapers).

Moreover, it is worth noting that, similarly to illustrative variables, the clusters resulting from the previous analysis are also representable on the factorial space. This enables a deeper interpretation of them in terms of their mutual relationship with the components of the semantic structure.

Results

The matrix subjected to analysis was composed of 11617 ECUs (in row) and 1252 lemmas (in column). The Cluster Analysis division into four clusters was chosen as the optimal solution. Table 2 presents the most representative lemmas characterising the 4 clusters, which have been interpreted as follows:

Theme 1. Pandemic trends. Lemmas concerning the evolution (e.g., days, week, years) of the pandemic (e.g., coronavirus, covid-19) and the spread of new cases (e.g., new, number, cases, contagion, resulting) in the Italian context (e.g., region, Lombardy).

Table 2. Lemmas characterizing the four clusters

		Cluster 1		
Lemmas	*F*	*TOTAL*	*Chi-square*	*p*
Casi	2818	3491	2149.60	0.000
positivo	1584	1857	1424.88	0.000
morire	1690	2046	1380.35	0.000
decesso	1034	1101	1213.47	0.000
morto	1250	1442	1177.43	0.000
paziente	1593	2012	1137.17	0.000
ricoverare	864	894	1091.39	0.000
ospedale	1570	2037	1024.43	0.000
intensivo	802	891	839.05	0.000
contagiare	1074	1334	807.90	0.000
		Cluster 2		
Lemmas	*F*	*TOTAL*	*Chi-square*	*p*
governo	771	1318	795.94	0.000
conte	376	460	793.97	0.000
ministro	588	903	780.77	0.000
Decreto	284	327	670.32	0.000
Misura	848	1636	635.13	0.000
scuola	423	676	512.57	0.000
presidente	650	1305	432.84	0.000
attività	461	839	404.63	0.000
premier	266	384	403.69	0.000
sospendere	256	369	389.76	0.000
		Cluster 3		
Lemmas	*F*	*TOTAL*	*Chi-square*	*p*
economia	416	674	1482.64	0.000
economico	374	725	1004.97	0.000
Pil	184	224	986.25	0.000
globale	258	432	874.02	0.000
mercato	262	516	685.46	0.000
produzione	202	358	626.40	0.000
miliardo	265	557	621.24	0.000
crisi	325	783	597.01	0.000
impatto	183	316	590.98	0.000
dollari	130	182	573.43	0.000
		Cluster 4		
Lemmas	*F*	*TOTAL*	*Chi-square*	*p*
vaccino	387	522	933.75	0.000
virus	1342	3286	859.66	0.000
animale	312	448	672.93	0.000
umano	242	359	491.39	0.000
ricerca	336	641	407.80	0.000
vaccini	139	176	373.68	0.000
nostro	627	1592	357.88	0.000
sperimentazione	127	161	340.71	0.000
farmaco	230	402	337.73	0.000
proteina	82	84	309.70	0.000

Note. F: frequency in the clustered segments; TOTAL: total frequency in the corpus.

Theme 2. Health protection. Lemmas concerning the health (e.g., health) protection measures (e.g., measure, to close, activity) set by the Italian institutions (e.g., government, president, minister, Italian, Italy).

Theme 3. Socio-economic consequences. Lemmas concerning the social (e.g., social, services, group) and economical (e.g., PIL, million, economic, euro) impact (e.g., crisis, rise, tax) of the pandemic (e.g., pandemic).

Theme 4. Disease: causes and treatments. Lemmas concerning disease (e.g., virus, epidemic, respiratory, disease), the explanation (e.g., information, Sars) of its causes (e.g., infection, virus, spread) and treatments (e.g., care, vaccine, response, medication) provided by experts (e.g., scientific, international, expert).

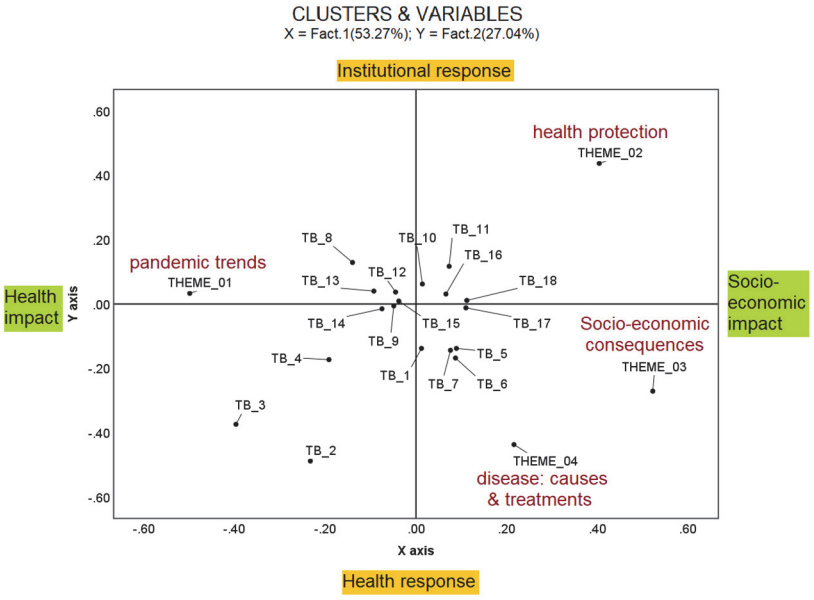
The Correspondence Analysis extracted two main factorial dimensions, that lend themselves to be interpreted as follows:

Factor 1. Health vs Socio-economic impact. One polarity of this factor groups lemmas referring to the impact of the pandemic from the health point of view (e.g., patient, hospital, department, doctor), in terms of contagions (e.g., swab, number, contagion) and disease/deaths (e.g., decease, sick, dead). The other polarity is characterised by the impact of the pandemic from a social (e.g., school, social) and economic (e.g., recession, price, debt) point of view, which has engaged the institutions (e.g., president, government, premier) in finding a way to manage (e.g., decree, investment, measure) the crisis (e.g., emergency, crisis). Taken as a whole, the factor can be interpreted as indicative of a global view of the "content" of the pandemic, represented by terms of its impact – namely, the pandemic as a health versus a socio-economic issue.

Factor 2. Health response – Institutional response. This factor is characterised by the juxtaposition between, on the one hand, lemmas concerning the scientific and medical response to the pandemic crisis – namely in terms of scientific development of resources (e.g. research, produce, researcher, vaccine, medication, develop) for the safeguarding of health (e.g., life, immune, antibody) and, on the other hand, lemmas concerning the institutional and political response (e.g., decree, ordinance, provision, minister, government, president). Thus, the factor can be interpreted as indicative of the engagement with the

pandemic crisis – the pandemic as a crisis to be addressed in terms of health versus institutional response.

Figure 1. Semantic structure of the covid-19 representation and position of illustrative variables and cluster on it



Note. TB= Time Block; PO= Political orientation (C/L=to center/left, C/R=center/right, C= center).

Figure 1 shows the position of the themes within the space defined by the factorial dimensions. Theme 1 (Pandemic trends) turns out to be the only one to approach the Health impact polarity of the first factor; in fact, theme 2 (Health protection), theme 3 (Socio-economic consequences) and theme 4 (Disease: causes and treatments) tend to be associated with the Socio-economic impact polarity. As to the second factor, theme 3 (Socio-economic consequences) and 4 (Disease: causes and treatments) tend to be associated with the Health response polarity, while theme 2 (Health protection) to the Institutional response polarity; theme 1 (Pandemic trends) is not characterized by the second factor. Figure 1 also provides the projection of the two characteristics of the texts investigated – i.e., time of publication and political

orientation of the newspapers – over the factorial space. However, with the exception of times 2 and 3 whose contents are found to be focused on the health dimensions (in terms of impact and response of/to the pandemic), no significant patterns emerge.

Discussion

Results of the analysis provided insight into Italian newspapers' representation of covid-19: on the one hand, the contents of representation (i.e., themes) were identified; on the other hand, the semantic structure underlying such contents was mapped. The adoption of this dual methodological focus was aimed at broadening the interpretive framework, integrating the recognition of the media's ability to frame the way of representing covid-19 with the analysis of how the media frames are in turn grounded on generalized meanings. The themes that emerged were found to be largely consistent with the frame literature. In fact, many of the frames identified both in the national and international literature can be seen to correspond with the themes that emerged from this study. For example, the first (Pandemic Trends) and the second (Health protection) themes that emerged from our analysis are consistent with the frames found by some scholars which showed that one of the major foci of the media discourse was the report of the number of cases and deaths and the actions governments took to prevent its spread (Rodelo, 2021; Uribe, 2020). Moreover, the frames focusing on political and social impact (Hubner, 2021; Ophir *et al.*, 2021), as well as frames focusing on economic emergency (Dahal & Khatri, 2021; Poirier *et al.*, 2020) highlighted by the literature can be associated with the third (Socio-economic consequences) theme found in the analyses, which specifically focuses on the economic and social consequences of the pandemic. The frames concerning the symptoms and effects of covid-19 (Ophir *et al.*, 2021) resonate widely with the fourth theme (Disease: causes and treatment), which concerns the disease specifically, and also the explanation of its causes and treatments provided by experts.

Specific to the Italian context, these findings are consistent with other studies (Busso & Tordini, 2022; Crabu *et al.*, 2021; Miconi & Risi, 2022) which state that media narratives related to covid-19 move within the following main frames: a political-institutional frame (cf.

Theme 2. Health protection and Theme 3. Socio-economic consequences) in which the pandemic is discussed mainly in terms of counter measures and economic and social relations; a scientific frame (cf. Theme 4. Disease: causes and treatments) related to the origins, clinical development and epidemiological profile of the pandemic; and a medical frame (cf. Theme 1. Pandemic trends) related to the general evolution of the contagion.

These data show that the pandemic has been framed primarily in terms of a health versus institutional problem. This dialectic also recurs within the semantic structure identified within this study, where the first factor refers to the effects of the pandemic in terms of its health, social and economic impact; again, the second factor refers to the management of the pandemic at the medical-health and political-institutional levels.

Our study investigated whether (a) political orientation played a role in influencing discourses about the pandemic and (b) whether the semantic structure of these discourses evolved over time. In contrast to other studies which claim that political orientation influenced the representation of covid-19 (Crabu *et al.*, 2021; Rodelo, 2021; Zhang, 2021), our analysis showed the political orientation of newspapers were not associated with the polarities of the semantic structure. This suggests that the political orientation of newspapers does not seem to have influenced the way news about the pandemic were reported. This may be due to the fact that our sample consists of national newspapers, thus inclined to reach a wider and more diverse readership, therefore, probably less politically polarized.

The same absence of relationship was also found between semantic structure and the time. In fact, also in this case in contrast with other scholars, who found that the discourse about the pandemic varied over different time periods – moving, for example, from a health-related frame in the early months of the pandemic to a political-institutional frame in the later months (Fatima, 2020) and vice versa (Pan & Meng, 2016) –, our results show that the themes had roughly the same importance over the 18 weeks covered by the study (January-May 2020). Thus, the representation of covid-19 in Italian newspapers – except for the first two weeks after the outbreak of the pandemic in which newspapers focused on health aspects in terms of impact and response of/to the pandemic – appears to be balanced; in fact, there is no polarization

on the semantic structure (cf. Figure 1). This aspect probably reflects two characteristics: on the one hand, the ability of Italian institutions to cope with the emergency – this is confirmed by the praise received by Italy about the management of the crisis by the WHO (https://lavocedinewyork.com/en/news/2020/09/25/who-praises-italy-for-its-exemplary-response-to-the-covid-19-crisis/), the New York Times (https://www.nytimes.com/2020/03/21/world/europe/italy-coronavirus-center-lessons.html) and the Financial Times (https://www.ft.com/content/6831be3e-2711-4ea3-8f62-daa82cf9ca11); on the other hand, a circular relationship of reiteration of meanings between a society culturally predisposed to integrate these aspects and the media that contributed to emphasize the medical-health and political-institutional aspects of the pandemic crisis.

The study certainly has the limitation of focusing exclusively on the analysis of Italian newspapers – and a restricted pool of sources. Therefore, generalizability of results should be done with extreme caution. However, our analysis did actually aim at describing the Italian context. For future research it would be useful, on the one hand, to take into consideration also more politically polarized newspapers; on the other hand, to broaden the time frame under analysis so as to monitor more accurately its evolution and to extend the analysis to different countries in order to make comparisons among them. The intercultural comparison would allow a clearer view of the processes underlying public discourse of socially important issues.

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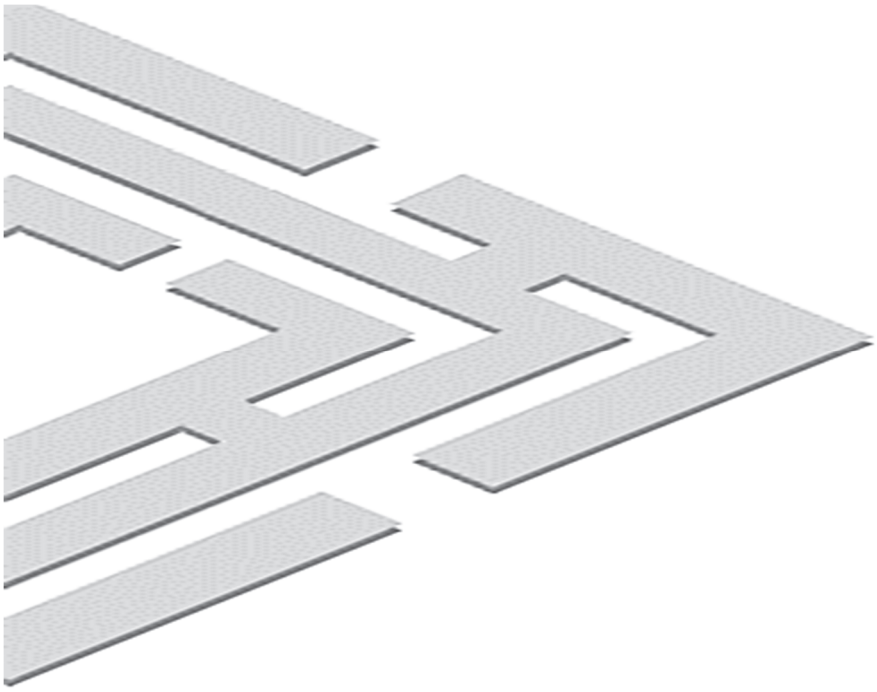
COMMENTARIES*



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Generating a beneficial creative chaos to manage compartmentalization in psychology: A trans-disciplinary approach to intertwine plurality and unity

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Abstract

The search for a composition between plurality and unity of psychology is developed here by articulating a reflection on three points concerning:

1. the origins of the phenomenon of compartmentalization that can be traced back to a dual configuration – plural and fragmented – of psychology; characteristics that are connected but not coincidental;
2. the acceptability of a trans-disciplinary approach to design a composition of psychology that respects its plural articulation;
3. the choice of the area of health as the elective phenomenical field to test the possibility of composing the plurality and unity of psychology starting from a trans-disciplinary approach.

Keywords: compartmentalization, plurality, fragmentation, professional psychology, trans-disciplinarity.

The position paper by Salvatore *et al.* (2022) that is commented on here deals with the phenomenon of the compartmentalization of the psychological profession, a phenomenon that we could also represent in terms of fragmentation and self-referentiality of professional practices. More specifically, the paper describes the current situation and

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puts forward a synoptic picture of the strategies deployed today to support a greater unity of psychology on a theoretical and pragmatic level.

Let us observe how the choice of anchoring the reading of the compartmentalization of psychology to the pathway of the construction of the profession – and not only to a formal epistemological analysis – is an opportune and shareable option from at least two points of view. From one side, it reinforces the perception of a problem certainly present in the psychologists' community (cf. Kazdin, 2008) and confirmed by empirical research on the profession (cf. Bosio & Lozza, 2021) but still rather weak in scientific reflection on the discipline[1]. On the other hand, the professional anchoring highlights questions of great importance that are still open today: how to manage "here and now" a dilemmatic polarization between compartmentalization and unity in psychology? And how to repair the resulting state of fragmentation: a state destined to depower the discipline in its capability to construct responses to an increasingly challenging, multi-faceted and complex social demand for psychology?

To start from the pathway of the professionalization of psychology thus seems to configure a good laboratory for analysing our theme, as is also shown by the reconstruction of the "state of the art" proposed by Salvatore *et al.* (2022). I intend to start from this reconstruction in order to develop a reflection structured around three main questions schematized as follows.

1. What lies at the origin of the phenomenon of compartmentalization of the psychological profession and what are the generative roots of the phenomenon? In particular, are we dealing with an insuperable or manageable problem in the construction of the discipline?
2. How to configure an approach capable of linking plurality and unity in psychology? More specifically, is it possible to design a purposive process methodology from a trans-disciplinary approach?
3. And lastly, can the area of health (pivotal example reference in the paper by Salvatore *et al.*) be taken as a good area of test for linking plurality and unity of psychology in a trans-disciplinary key?

[1] A quick exploration conducted in Google Scholar for the period 1990-2022 from the keywords given here (unity of psychology, psychology unification, psychology fragmentation, psychology compartmentalization) shows a weak attention to the topic evenly distributed over time: the total contributions recorded are about fifty with a rate of a few units/year.

Plurality and/or fragmentation of psychology? At the root of the phenomenon of compartmentalization

Plurality and fragmentation are clearly configured as overlapping characteristics in the current structure of psychology. From here, a question imposes itself: are we dealing with coincident predicates of psychology or with distinct characteristics that the historical path of the discipline's construction has connected? Disambiguating the point is important: are we dealing with a sort of "original sin" (not amendable) or with the outcome of a contingent process (susceptible to reconfiguration)?

From my point of view, the second option appears more persuasive and sustainable on the basis of arguments that concern both the scientific and the professional set-up of psychology.

From a scientific point of view

The plural structure of psychology is configured first and foremost as a scientific response to the exceptional semantic breadth of the phenomenon to which the discipline is dedicated (a phenomenon with many faces categorized as: subject, mind, body, behaviour, relationship, individual, group, thought, language, emotion, discomfort, disorder, disease ...). This response – it is well known – has always been articulated on a wide variety of paradigms selectively focused on a subset of properties of the phenomenon identified as priorities.

The resulting plurality of theories and methods thus appears to be a constitutive fact of psychology that must be taken into account. First of all, to recognize the potential and limits of a paradigm with respect to the extension of the phenomenon of reference... unless we resort to options such as "psychology is my psychology", expression of a reductionist and hegemonic tendency that seems to have generated more difficulties than opportunities for psychology[2].

[2] It is well known (see e.g. Agazzi, 1976) that the choice of a paradigm is based on "a priori" – anthropological, cultural, value, ideological... assumptions – that are foundational to the paradigm itself. Any paradigm, therefore, is intrinsically limited in its capability to offer a total understanding of the phenomenon: both in terms of

We are therefore faced with an initial root of the phenomenon of compartmentalization that can be traced back to a plural structuring of psychology as a science. We know that, on a historical level, the management of this structural datum has clearly privileged – in line with the dominant mainstream in the scientific world (cf. Bosio & Morelli, 2015) – the internal growth of single paradigms in the logic of their hyper-specialization, underestimating the construction of systemic links between the various "visions" of psychology. This choice is now showing its penalizing effects for a multi-paradigmatic science such as psychology (cf. Henriques, 2004) but it must be recognised that this was a historical option and not an inevitable consequence due to the epistemological set-up of the discipline (cf. also Walsh-Bowers, 2010) therefore liable to new paths of response to plurality.

From a professional point of view

Similarly to what we have just seen, a growing plural articulation can also be observed in the frameworks of the psychological profession: some of them already codified for some time within standard classifications (see the taxonomy proposed by the APA), others more recent, fluid and in progress generated in the sphere of neo-professionalism (cf. Bosio, 2011).

This is – it should be clarified – a phenomenon analogous to what has been detected on a scientific level but autonomous and autogenous in relation to it. This, having to do with the concrete and contingent (historical-social) conditions within which the professionalization of psychology has been generated and is regenerated by a social demand of psychology even more varied, complex, and multi-faceted.

These conditions can be synthetically traced back to two main orders of factors: on the one hand, the characteristics of the phenomenon identified as elective that are at the origin of a professional service

the selective spectrum of phenomenal characteristics observed, and in terms of its foundations external to the paradigm itself.

This condition – it should be pointed out – certainly concerns psychology but not only that, extending to all empirical sciences, as evidenced by Godel's incompleteness theorems (cf. Raatikainen, 2013) a mathematician ready to remind us that "what we can know is much more than what we can prove (from a paradigm)".

(what salient dimensions of the phenomenon trigger a demand-supply of psychology?); on the other hand, the presence of lay actors (stakeholders) bearers of a demand – implicit or explicit – for psychology (what space to give them in the development of the profession?)

A specificity/autonomy of professional contexts is thus emerging, which poses difficulties: on the one hand, the prospect of constructing a profession as a pure replication of the scientific set-ups of the discipline[3]; on the other hand, the possibility of marginalising the role of the social contexts and the stakeholders in the creation of a professional project[4].

In the face of this situation, the phenomenon of compartmentalization described by Salvatore *et al.* (2022) well represents the current state of the psychology profession within which plurality and fragmentation of professional contexts tend to be confused within a single offer. It is therefore necessary to disambiguate between the opportunities linked to a plural articulation of the profession and the limits of separate practices that have difficulty communicating with each other and legitimising each other. In short, we are facing the challenge of designing a good composition of the various professional paths of psychology within a common and shared frame; a task that cannot be entrusted to theories alone nor to the experience of individual communities of practice (Wenger, 2009), which for the most part generate a tacit and implicit knowledge (Polanyi, 2009) exposed to the risk of self-referentiality and to the esoteric short-circuit of communication.

[3] The linear "pure research-> applied research" model, however deeply rooted in the scientific tradition, does not seem to reflect the possibility of the "many ways of applying" in psychology (see Bosio, 2012) nor answer the need to intertwine within a dedicated project elective properties of a phenomenon and specificities of a paradigm. This actually opens up a reconfiguration of the model in an interactive logic: "applied research ←→ pure research".

[4] Scientific expertise does not seem to be able to manage a professional design on its own: in the face of a growing demand for the participation of lay actors (including the citizen-consumer and the consequent recognition of a role for the citizen scientist, see Stilgoe, 2009) and in view of the evidence that the quality – both objective and perceived – of the professional outcome is also linked to such participation (with reference to the health context, see Graffigna & Barello, 2018).

Combining plurality and unity in psychology: a trans-disciplinary proposal

To summarise the picture that has just been outlined: a) psychology appears to be guided by a double internal dynamic that orients it towards plurality (basic structural fact) and towards fragmentation (historical construction in response to the structural fact); b) plurality and fragmentation, although different, are interwoven and characterise both the discipline and the psychological profession; c) the phenomenon of the compartmentalization of psychology represents the final negative outcome of this dynamic that calls for a threefold reparative intervention on the discipline, on the profession, and on the relationships that regulate discipline and profession.

On this point, the paper by Salvatore et. al (2022) proposes an effective synoptic framework concerning the strategies implemented to contain/resolve the fragmentation of psychology, outlining three paths defined as: "search for ultimate explanation" (search for a paradigm deemed capable of unifying the theoretical status of psychology), "strategy of extension" (progressive coverage of the different thematic areas of psychology by the same paradigm), "meta-theoretical framework" (systemic configuration capable of composing the theoretical and practical articulations of psychology within a unitary second level framework). These are three options that configure at the base a different response to the structure of psychology: the first two in a monoparadigmatic key, reducing the current state of fragmentation of psychology by overcoming its plural paradigmatic configuration; the third in a systemic key, linking the many faces – theoretical and practical- of psychology within a unitary framework of a higher order.

A few considerations on the first two options. Both are oriented towards constructing an answer to the problem through the extension of a single paradigm, but following different paths: the first, on a theoretical level (see, for example, the path advanced with reference to evolutionary psychology described in the paper by Salvatore *et al.*); the second, on a pragmatic level (see, for example, the scope extension of neuroscience to construct a single umbrella capable of integrating the various domains of psychology: Cacioppo, 2002; Stam, 2015). These are, first of all, still emerging working hypotheses whose evaluation can be made in the long term on the basis of their outcomes and

are therefore of little use for a "here and now" management of the problem. Moreover, we are faced with paradigm unification projects destined at best to reduce the internal plurality of psychology but not to eliminate it at its roots, the gap between the semantic complexity of the phenomenon studied and the selectivity of the paradigmatic point of view chosen being insurmountable, as seen above.

From what has just been said it follows that the third way (meta-theoretical framework) should be considered carefully for two reasons: contingent (plurality is a constitutive datum of psychology that cannot be overcome in the short-medium term) and epistemological (the plurality within psychology can be reduced but not overcome due to the heuristic selectivity intrinsic to each paradigm). It will therefore be worthwhile to focus on investigating the possibilities of developing the third way by designing the implementation paths of a meta-theoretical framework.

In this sense, I offer a possible interpretation of the task – certainly not the only one – from a trans-disciplinary perspective. A theoretical-practical perspective oriented towards integrating epistemological-formal attentions in the analysis of the socio-historical process of constructing scientific knowledge and its applications. Developed in the last decades (on the impulse of some founding fathers such as Piaget, Morin, Bateson, Nicolescu...), the trans-disciplinary approach can be summarised in its founding traits as follows (for more details, see: Nicolescu & Ertas, 2008; Schweizer Ries & Perkins, 2012; Polk, 2014; Bernstein, 2015; Bosio & Morelli, 2015; Scholz & Steiner, 2015):

- attention to the sciences as a system of knowledge and to the path within which this system is constructed;
- recognition of the limits of scientific development based on an increasing separation between the sciences in terms of specialisation and hyper-specialisation;
- need to generate interconnections between the sciences in order to overcome the current state of fragmentation and self-referentiality (a need not satisfied by multi- or inter-disciplinary meeting logics aimed at building comparisons in additive logic but not substantial integration processes between different sciences);
- awareness of a growing social demand for scientific knowledge and

applications to be constructed in a polyphonic manner to respond to increasingly challenging and complex problems;
- awareness of the need to redesign relations between science and the outside world in order to foster the active participation of the lay (non-scientific) actor and the co-authorship of research and intervention paths;
- need to develop a process methodology capable of virtuously guiding the encounter between expert actors from different scientific backgrounds, as well as between expert and lay actors;
- propensity to anchor the development of a trans-disciplinary approach to concrete contexts of encounter between social demand and scientific supply within which shared co-designing can take place.

To summarise, it is evident how the trans-disciplinary perspective configures a response to the need to bring the sciences into dialogue: with each other and with the social contexts of reference. This point will be taken up in its implications for psychology in the last paragraph of this paper. What I propose here is to transfer and test the viability of a trans-disciplinary approach within psychology, given the evident paradigmatic and applicative fragmentation of this discipline: is it possible to compose plurality and communality in psychology in a trans-disciplinary key? The exercise is obviously exploratory, not only because it is in its beginning stages, but also because it may rest on a frame of reference still in progress in its configuration. While accepting, however, the degrees of provisionality and uncertainty involved, it is possible as of now to focus on certain meritorious points worthy of attention that can be schematised as follows.

Process-centeredness

The contribution offered by a trans-disciplinary approach is clearly of a meta-theoretical and meta-contextual nature since it does not concern the contents related to a paradigm or to the generative context of a practice but considers the construction process of these two worlds: within and between them. Hence the possibility of designing a frame of reference of a processual nature capable of articulating within common and shared methodological anchorages the plurality of disciplinary contents and practical contexts that populate psychology.

Project-centeredness

A trans-disciplinary approach hardly adapts to abstract modes of comparison but requires the construction of experiential frames within which to develop paths of encounter between expert knowledge oriented by a common triangulation on a real context that is the bearer of a question. I read here – in agreement with the choices made by Salvatore *et al.* – the possibility of identifying the professional context as an idealtype place within which to operate an integration between plurality of content and commonality of process in order to favour a decompartmentalization of psychology in a trans-disciplinary key.

Conceptual analysis and formal ontology: two anchors for a trans-disciplinary design

A process methodology needs its articulation on the operational level. In this perspective, certain philosophical contributions in support of the method appear particularly promising: in themselves and for the derivatives that follow in the field of psychology (see, for example, Yanchar & Slife, 2000). I am referring to conceptual analysis and formal ontology as theoretical-methodological artefacts capable of guiding a path of comparison-composition between different scientific knowledge: among themselves and in their relationship with the phenomenical world (for further study see: Laurence & Margolis, 2003; Guizzardi &Halpin, 2008). These approaches are already present in the field of psychology (cf. e.g.: Ward, Haig, and McDonald, 2022; Martin, Sugarman, and Stanley, 2015), also with reference to the issue of the fragmentation of the discipline (Marsh & Boag, 2014; Hibberd & Petocz, 2022).

Conceptual analysis seems particularly promising in supporting the path of clarifying the semantic spectrum of a paradigm beyond entropies and linguistic overlaps ("what theoretical object am I talking about?") a preliminary operation to a comparison with other paradigms engaged in reading the same phenomenon (cf. Baldwin, 2008; Tobon, 2018; Hibberd & Petocz, 2022).

Formal ontology, starting from the contribution offered by conceptual analysis, lends itself well to constructing a syntax regulated in

logical-formal terms between the properties of a paradigm and the properties of a phenomenical reality, or between scientific worlds and lifeworlds. We are talking – it should be made clear – about a space of definition free from substantive veritative concerns, (i.e. concerning the "true essence" of the phenomenon) but rather aimed at configuring a space of encounter/confrontation between otherwise incommensurable cognitive worlds (cf. Guizzardi & Halpin, 2008; Basli, 2015; Guarino & Musen, 2015).

Attention to the pragmatic and the quality of the path

The clarification of the logical-formal conditions on which to guide a trans-disciplinary encounter process can certainly mitigate the criticalities of an experiential pathway, but it would be excessive to expect the complete abolition of the problems linked to the complexity of the process (subjectivity of the actors and non-linearity of the situations..). As a matter of fact, the confrontation between different disciplinary universes and between scientific and lay knowledge asked to co-operate within an open project – which cannot be foreseen a priori either in its development or its outcome – implies the taking into account of pragmatic criticalities to be read and managed in the operational flow of the working group. The need to cope with "confusing...hybrid...non-linear...turbulent..." path junctions (cf. Aargard & Hansen, 2007) or manifestations of monopolistic temptations by "strong sciences" inclined to occupy the thematic field in a monodisciplinary key (cf. Bosio, 2021) or even the marginalisation of lay actors in practice (cf. Van Bewer, 2017) is therefore to be expected. These are not insignificant problems that psychology seems to be sufficiently equipped to manage, having developed an appreciable wealth of knowledge and skills to support a good pragmatics of the encounter capable of fostering reciprocal fertilisation between the actors and positive effects on the creativity of the outcomes.

Health: a testing ground for a trans-disciplinary approach in psychology

The paper by Salvatore *et al.* explores the phenomenon of compartmentalization of psychology mainly in the area of health; a choice linked to the scientific-cultural specificity of the authors and the journal but also projected onto a broader dimension of meaning. The reasons for starting from the area of health to test a trans-disciplinary approach in psychology are different but all converging in connoting health as a pivotal area (cf. for more details Bosio, Barello and Graffigna, 2021):

- most psychologists find in health an elective area of reference both scientifically and professionally;
- health today configures a multi-faceted area that crosses most of the disciplinary and professional articulations of psychology;
- in this area the phenomenon of compartmentalization appears substantial, as does the opportunity of overcoming it: the difficulties of constructing a compositional framework of commonalities and differences on the scientific and professional level but also on the training level are evident (cf. Bosio, 2022a);
- finally, health appears to be an area in which psychologists are often confronted with other disciplines (medicine, but not only) that operate on the same themes and within the same spheres of action; to call oneself out of this confrontation would seem to destine psychologists to a sort of marginalisation, in particular with reference to the public health and welfare sphere (the Covid-19 experience is illustrative in this regard; cf. Bosio, 2022b).

There are therefore many and consistent reasons in favour of a commitment of psychology from a trans-disciplinary perspective in the area of health. A commitment that could strengthen its paradigmatic and professional construction in terms of de-compartmentalization but also increase its capacity for positioning and cooperation in scientific and professional projects increasingly marked in a trans-disciplinary sense. More than a wish, a necessity.

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"E pluribus unum"? From colors to psychology

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Abstract

The commentary deals with multiplicity vs unity in psychology, contrasting the compartmentalization of psychology as several different disciplines. The problem has significant repercussions on the professional level, given that the psychologist under Italian law is authorized to work in all fields of the psychological profession, except psychotherapy for which specialist training is required. Possible unifying criteria, epistemology and methods common to the entire psychological science are sought. The applicative aspects for training, in light of the new norms on the qualifying degree in psychology, are discussed.

Keywords: psychological profession, epistemology, psychological methods, training.

Multiplicity vs unity in psychology: a professional perspective

"*E pluribus unum*" – Is this motto (firstly attributed to Virgilio with reference to colors, and adopted for many historical seals and coins) applicable to psychology? Can a coherent picture be built up by

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differently colored and shaped pieces of the puzzle of a seemingly fragmented psychology?

The compartmentalization of psychology is an ancient issue. In the first year of publication of the *Review of General Psychology*, Yanchar and Slife (1997) exposed the concern that «disciplinary fragmentation is precluding the accumulation of knowledge and catalyzing the dissolution of institutionalized psychology» (p. 235). Many attempts have been made to search for unity (e.g., Staats, 1999; Henriquez, 2011), but much mistrust remains: «If there is a kind of unification in psychology's future, it is more likely to be one that, paradoxically, sees it broken up into a number of large 'super-subdisciplines', each of which exhibits more internal coherence than does the current sprawling and heterogeneous whole» (Green, 2015, p. 207).

Recently, the problem has been reported to professional psychology.

Saks (2016, p. 170) highlighted «the ongoing significance of professions in the fast changing modern world. There are debates about their current levels of autonomy, but within their new organizational and societal context professional groups remain powerful with a growing theoretical literature on their nature and role». According to Burns (2019), professions should re-think their position to meet the demands of social policies, organizations and consumers. «Professions are made up as they go along» (p. 65).

With reference to the psychological profession, Salvatore *et al.* (2022) underline that the two main lines of its development – expansion and specialization – are intertwined. Are these trends also reciprocally dependent, i.e. expansion requires specialization, creating several psychological subdisciplines, each with different epistemological and theoretical backgrounds and different specific methods? «The repertoires of knowledge of most professional psychology are based on or comprise short-range models that tend to operate in reciprocal isolation, as self-contained systems of theory and practice, ending up being separate territories, with weaker and weaker reciprocal linkages … This separation is sanctioned and further fueled by the separation between scientific communities, each with its own organizational structures, contexts, and communication tools (conferences, journals, scientific associations)» (Salvatore *et al*., 2022, pp. 10-11).

But, according to the Italian laws, the psychological degrees and

the habilitation (now to be included within the degrees themselves) regard all the fields of the psychological profession, except only the specific practice of psychotherapy, requiring a formal specialization. Therefore, all psychologists enrolled in the professional Order can work in all the fields of applied psychology, although this possibility is hardly realizable in concrete professional activity. How can this hypothetical and forced unity be represented and sustained by a community expanded and specialized in its scientific and formative bases?

In search for unifying criteria

The socio-biologist Edward Wilson (1998) argued for the fundamental unity of all knowledge and the need to search for what he calls "consilience", i.e. the composition of the principles governing different branches of learning. Unifying the knowledge from different fields, consilience allows identifying powerful simple shared truths, overcoming the excessive fragmentation and specialization of knowledge. This approach is useful both across and within sciences, and can be applied to the different theoretical principles grounding "psychologies".

According to Salvatore *et al.* (2022), a criterion is needed to compare the different approaches, with the aim of preventing the fragmentation of psychological science, and the intervention is proposed as a benchmark for finding this unifying criterion.

In previous articles (Di Nuovo, 2020, 2021) I suggested that the theoretical precariousness of psychology as a unitary science could find support by:

- a search for relations between *objective* observation and individual and social *subjectivity* – also with the help of models based on Artificial Intelligence, useful to cope with the dynamic complexity of the objects of study;
- the *transdisciplinarity* as a working strategy. In the "transdisciplinary" approaches (Bosio, Graffigna, and Barello, 2021; Nicolescu, 2008) each science maintains its own specificity but together with the others, and with the social actors, designs, implements and verifies the construction of a society with less discomfort and more well-being. This approach is useful not only

between different sciences but also *within* the same discipline when it has several different theoretical and methodological models.

The target of the Salvatore *et al.* (2022) article is the professional, not only the academic and scientific, psychology. But are these separate worlds? Surely not, when psychological theories and applications are strongly connected, and this happens out of the laboratory where the variables are few and easily controlled. When variables are several, acting joined and without the possibility of reliable multivariate control, and modifying in time, attention should be focused on the methods of suitable applicative experimentation. An approach is needed that – without renouncing the rigor of the scientific method – aims not only at increasing knowledge and at verifying theoretical hypotheses but at modifying, through the experimental treatment, the object of study. Reference should be made to those sectors of psychological work in which the intervention is usually contemporary (and not subsequent) to the research, and the researcher is at the same time operator of a change to which clients and/or stakeholders are primarily interested. This happens in forensic, educational, and rehabilitation applications, in the psychology of organizations and institutions, of sport and leisure, etc. Particularly interested is clinical psychology (for prevention, counseling, and therapy), where professional interventions have been often separated from experimental approaches.

The traditional dichotomy between "basic" researchers and operators who "apply" the results of the research should be overcome. Near half a century ago a textbook, after reviewing the possibilities of the use of psycho-social theoretical models in clinical practice, concluded:

> «We need controlled studies on theoretical relationships. We need a theoretical framework to operate as clinicians. But the clinician does not have to carry out this research himself. He has to keep himself informed about it ... Basic researchers and clinicians are in a productive, symbiotic relationship. Some trace the general principles; the others apply them to the real world» (Brehm, 1976, p. 237).

Thus theorizing a radical separation between "who does" and "who does research". The time is ready to think of a figure of worker-researcher capable of combining psychological practice with the scientific logic of the *research-action* described by Lewin. The logic that

allows us to scientifically evaluate our own work without artificially separating the moment in which research is carried out and that in which the results are "applied".

Without verifying efficacy and process of psychological interventions, professional psychology cannot be scientific – and cannot be socially useful, as requested by social stakeholders.

In search for common methods and epistemology

For this approach, psychology has several methods, from multicentrum approaches to longitudinal and qualitative, idiographic methods. But, beyond methods, a unifying epistemology is needed.

Petocz and Mackay (2013) proposed that "situational realism" offers a unifying framework for psychology. «The approach is characterized by seven themes: ontological egalitarianism; situational complexity and process orientation; a network or field view of causality; a realist logic; a view of relations as nonconstitutive; an externalist relational approach to mind; and acceptance of critical inquiry as the core scientific method» (p. 216). This approach offers psychology a meta-theoretical framework to integrate hermeneutics and semiotics; allows expansion, redirection, and unification of psychological research methods, and has relevant consequences in the practice and teaching of psychology.

Sandage, Cook, Hill, Strawn, and Reimer (2008) demonstrated the utility of hermeneutical applications to psychology as a whole and to some specific sub-disciplines (e.g., social and developmental psychology, psychoanalysis). Using both explaining and understanding the hermeneutics both discovers and constructs the reality, and this is particularly useful in applied psychology.

The hermeneutic approach is based on the constructivist ground of our knowledge that is aware of the limits of defining variables and trying to measure them (i.e., the traditional model of research and explanation). This approach includes the analysis of empirical data, obtained by observing selected variables, or an action as a whole in its development, analyzing quantitative and qualitative data based on techniques of assessment suitable to the aims of the study. But the hermeneutic approach goes beyond these simple and single analyses, connecting these data with others and exploring the topic of the research

in a cumulative way, as allowed by widespread statistical techniques (e.g., meta-analyses).

In search for formation

The last (but not least) issue to treat in search of a core epistemology for the psychological profession regards the *formation* to the way of building scientific applicate psychology, at the different levels: basic courses; Ph.D.; specializations in clinical and other fields of psychology, advanced training courses. In all these levels, including several formative contexts, the main problem is what model of psychology will be presented and, if models are different, what implications are needed in translating each model in professional practice.

Should the theoretical model each psychologist follows in his/her work remain fixed, i.e. the same on every occasion, or should it vary according to the requirements of the client or the context? For example, will the psychologist use the same model both in private and public practice, e.g., when it has to be applied in juridical or penitentiary contexts? Or should (s)he be able to integrate the basic model with approaches and techniques derived from other models more suitable for the specific contexts? In other words, the problem to solve is whether the model which mainly influenced the psychologist during the training (especially in the specialist formation), and of which (s)he is an expert, can always be strictly applied, or rather if the model can be modified when needed by implementing the so-called "integrated intervention" (both educational, or counseling, or therapy). In this perspective, it is needed to avoid the risk that this integration will become an ineffectual mixture of methods and techniques assembled without scientific rigor, only based on (possibly faulty) personal intuition that may cause great confusion and useless procedures. The training itself should teach how to integrate the models to answer specific targets and contexts of intervention, using appropriately the supervised practice as the recent Italian law on the habilitating degree requires. Teachers and tutors should be prepared for this, to build a project of formation useful for an integrated and transdisciplinary psychological profession.

"E pluribus unum": a challenge for a meaningful picture of current psychology…

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Relationships Give Coherence to Psychological Theories

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Abstract

The ability to allow unitary meaning to emerge from the fragmentation of theoretical approaches in psychology may come from posing methodological attention to one facet of observed behaviors, that of relationships. The author aims at creating opportunity for establishing a thought process for the reader on the ongoing enactment of separating the objective from the subjective nature in psychological inquiry and theoretical formulations within the field. This written contribution can be seen as a participation in a dialogue with other authors in response to the position paper of the current issue by advocating for a meta-theory that unifies diverse theories and observations while also attributing relevance to specialized areas of study and intervention in psychology that partake in a recursive relationship with each other. In conclusion, the author also articulates ideas on the stance that a unitary meta-theory in psychology grounded on the relevance of intersubjectivity can offer to current collective or societal crises.

Keywords: meta-theory, fragmentation and unity in psychology, relationships, crises response.

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Psychological experiences, unlike cells, fibers, chemical reactions and other biological constituents, do not exist as "observable entities" that remain the same across observers and across time. Scientific literature in our field consists, among others, of a well-shared conceptual framework that governs our approach to studying observable behaviors which cannot be reduced to a scientific methodology capable of identifying psychological phenomena outside of the observer. In this conceptual framework, the observer of psychological phenomena, the scientist that measures behaviors and mind processes, cannot be an entity outside of a relationship with the observed.

This manuscript, as a commentary, a dialogue on the matter, in response to the position paper of the current issue, "Compartmentalization and unity of professional psychology: a road map for the future of the discipline", aligns with the need for a meta-theory that affords for more complexed, nuanced observations able to support a methodological strengthening in the field.

Scientific authors often stated that the methodological weakness of psychology as a scientific discipline lies in the problem of replicating and measuring an observed phenomena multiple times and expecting the same behavioral objective outcomes each time. In a recent paper Michael Mascolo (2020) points out that the issue with forming a unified psychological science is not one that sees psychology as excessively irregular or inconsistent in its attempt to be both grounded in the biology and the cultural variables of the observed individual, but one that does not consider the fact that scientific inquiry is to be at a psychological level itself. Mascolo (2020) argues that emulating the methodology of the "hard" sciences will not lead to progress in the formation of a fundamental psychological science. Natural scientists do not need to consider how their objects of study (atoms, projectiles, or organ systems) perceive their own worlds in order to understand them; psychological scientists, on the contrary, do.

The need to chase away subjectivity from the measured psychological phenomena has created, as in the behaviorist paradigm, for example, a limited understanding of the actual behaviors observed and a difficulty in generalizing the same observations to different ecological conditions. Overcoming the tension between subjective and objective nature of scientific inquiry in psychology might have pushed us too far into emulating other scientific disciplines while ignoring the

chance to form a unified theory of psychology from focusing on the intersubjective nature of the experience, as it arises between people in joint actions (Mascolo, 2020). This is to say that finding a broad psychological meta-theory that can encompasses the need to generalize observations from the empirical to the abstract and then back to the individual circumstances by recursively signifying them with greater complexity of understanding, may not exempt from identifying the intersubjective engagement in a shared relationship as the core (actual) object of study for all scientific observations in psychology. Psychological phenomena always happen simultaneously at a biological, individual and cultural level, as well as at a relational level between these.

Moreover, psychological concepts forming the core principles of a meta-theory of psychology through solid definitions of what the mind is or what anxiety or anger are, what are the reasons for a motivation to relate to others etc., can only emerge from studying self-organizing dynamic systems of relationships. In essence, there is no psychology without a relationship that forms and is formed by different biological, individual, and socio-cultural contexts of interaction. Anger and anxiety are emotions that cannot exist and therefore cannot be accurately observed outside of their emergence from the relational experience that individuals have with their world. A meta-theory that is based on a relational definition of psychological phenomena can inform abstract generalizations of why we do what we do, not because "we are who we are" but because we always find ourselves caught behaving in relationships of exchanged meaning between ourselves and our ever-changing biological and socio-cultural selves.

Relationships confer complexity to the observed phenomena by creating a context of meaning. When translating psychological science into professional psychological interventions, we can see this being clear. A multiplicity of theoretical approaches to clinical work unquestionably subscribes to the evidence of the relationship formed between the client and the psychologist as a relevant element of change and efficacy of this work. The theoretical knowledge of relationship dynamics affords the psychologist with understanding and with identifying psychological phenomena emerging from the interaction with the client, as these appear at a biological, individual, and cultural level within the confinement of the professional space provided. The

fragmentation of theoretical approaches in the professional field, as we see in cognitive-behavioral approach on one side and psychodynamic approach on the other, has also sustained a fragmentation at a theoretical level of psychology. For example, concepts like schemas or biases have been traditionally thought to be eminently describing cognitive-behavioral mental processes, distinct from theories of the unconscious in psychodynamic conceptualization that may have been using different terms to refer to similar if not same mental and relational processes of same psychological observations of human behavior. The concepts of transference and repetition compulsion as an understanding of the implicit schema within cognitive science can be an example of this. Studying psychological phenomena as emerging from relationships can be the focus of a scientific psychology that intends to overcome this fragmentation and favor an integration of the different psychotherapeutic theoretical approaches to clinical intervention. The intersubjective focus allows to add complexity to clients' request for psychotherapeutic service. In a clinical field that encourages specialization, as in the northeastern American health care where I work, a need for simplification of clinical presentations often characterizes clients' requests. The bio-medical cultural model of course plays a part in it, but also the public understanding of psychology as being a multiplicity of areas of empirical intervention that specializes in problem solving theories of intervention, does. Specializations become expertise in breaking apart and analyzing the cause and effect of one's psychological experience and give reductionistic explanations of presenting symptoms. This can be very helpful in promoting precise diagnostic work, as in the work of a medical specialization, when someone suffers from the uncertainty of one's symptoms. However, I would argue that a specialization in psychology allows to promote an initial connection, a shared relational space, where the client can access the experience of being understood by someone "that knows" how he or she feels about the experience that the psychologist is "a specialist of." If I as client meet with a trauma psychologist, I can be relatively sure that he or she will immediately understand me in my experience of "undergoing traumatic incidents and not feeling like myself anymore". If I see an Obsessive Compulsive Disorder specialist, I can be sure not to be told "why can't you just stop checking several times". From the initial reassurance that a specialist can provide the client we can then

build on attachment processes, emotional narratives, schemas, in due course add complexity to the understanding of the experience unfolding in the relationship. This can emerge over time from the relational patterns between the psychologist and the client. Thus, we can say that ultimately the role of a psychologist is to add complexity to the client's experience of the problem presented, not to simplify it. This happens through the professional relationship offered him or her, grounded in psychological theories of relationships between individuals.

In the American Psychological Association there are 54 different Divisions. These are described as «interest groups organized by members. Some represent subdisciplines of psychology (e.g., experimental, social, health or clinical) while others focus on topical areas such as aging, ethnic minorities or trauma» (APA Divisions, 2022). Divisions are a great way to allow psychologists with specific interests to learn and participate in communities of researchers, practitioners, and maintain relevance in that specific theoretical area of psychology. Focusing on different areas of research, like publishing specialized journals on specific areas of psychology, Divisions favor immediacy of knowledge and learning, dissemination. The challenge here would be to promote and sustain meaningful communication across different Divisions, different researchers, authors in these "divisions of inquiry", that can facilitate a unitary meta-theory of psychology across Divisions, through common language and common methodology. We follow here a clear attempt through initiatives of Division 1 (The Society for General Psychology). In its mission statement, Division 1 is to «promote the creation of coherence among psychology's diverse evidence-based specialties, other scientific disciplines and the humanities. Encourages analysis of the merits and challenges of bridging concepts, methods, and theories» (APA Divisions, 2022). Their scientific journal, Review of General Psychology, publishes with interest in «articles that bridge gaps between subdisciplines in psychology as well as related fields or that focus on topics that transcend traditional subdisciplinary boundaries» (APA Divisions, 2022). On a brief and quick excursus of the journal's most recently cited articles, we can see relevant research on wellbeing, on dangers of social media and on the benefits of the wandering mind for developing intentional actions in the future. All these three articles could be a more valuable contribution to a general theory of psychology, I believe, if they placed more

attention on understanding the role of relationships and relatedness between the individuals and their wellbeing, the individuals and social media communication, the individuals and their future actions. This type of attention could enhance the identification of psychological theory concepts that can be identified across psychology disciplines or Divisions. The separate, specialized areas of the APA Divisions could benefit from discovering or defining the general theory of wellbeing, for example, using a theory of inter-relatedness between oneself and his or her world or oneself and others, that can generalize to different areas such as health psychology, trauma psychology, couples and family, development and aging, just to mention a few of the Divisions present in the APA.

At the time of writing this contribution, the APA main webpage, www.apa.org, reports on recent changes in how mental health is experienced by workers on the job. And states that APA's 2022 "work and well-being survey reveals 71% of workers believe their employer is more concerned about mental health now than in the past (APA, 2022)." This is one specific observation that adds to the evidence of relevant changes we have all undergone throughout the past couple of years because of the COVID-19 pandemic's lifestyle disruptions. It is the role of the APA and more broadly of the mental health field, to address a crisis in mental health that emerged from the loss of the usual expectations, patterns of interactions, sudden changes in social norms and level of safety for oneself and significant others. Psychology, by finding a scientific ground within a meta-theory of relationships, can provide appropriate sustainment in navigating this mental health crisis but also several broad crises that are related to it, including the more general health uncertainty crisis, the economic inequality crisis, the climate crisis, the political crisis, the migration crisis, the gentrification crisis, the education crisis and the substance abuse crisis, to name a few. A compartmentalization into different areas of research without a cross-bridging meta-theory renders psychology weak in addressing these crises. The mental health crisis promotes a reflection upon the relationship that society has with common struggles that individuals may experience in their lives and that they may conceal from others to maintain a shared collusion of social efficiency and productivity on the job, in school, etc. Communicating on ones' mental health has become in the past couple of years more commonplace in the media and

within institutions like schools, families, work. The toll of loneliness, social separation, physical and ideological, that the pandemic rendered undeniable, forced a much more open dialogue about mental health daily struggles (Castiglioni & Gaj, 2020). Among the socio-cultural changes COVID-19 promoted we see awareness expanding on the interconnectedness of different crises and it is becoming clearer how these are relationship crises, as in relationships with the environment, relationships we have with geo-political views, with rapidly advancing technology that our wisdom and morality is struggling to keep up with, and ultimately with ourselves and the limitations of the fragility of the human condition. Limitations have also emerged in our ability to confer meaning and relevance to our lifestyles, with the increased crisis of religious institutions that can historically provide a sense of identity and belonging. The rise of pseudo-religious extreme movements in the USA, spawning from divisive political views but also from a need for belonging within cultural identities, is a testament to an undergoing crisis of meaning, contextually to a lack of meaningful relationships (Mastropietro & Vervaeke, 2021). Different areas of psychology research can certainly confer a layer of understanding to specific crises as we could see, for example, with health psychology and the study of decision making towards the adoption of healthy behaviors for the containment of COVID-19 spread in certain populations. Even so, the requirement of an encompassing, coherent theory of psychology that can inform an understanding of decision making within different categories of relationships can facilitate meaning making of relevant changes across currently experienced relationship crises. A coherence of theories in psychology that focuses on relational or intersubjective meaning of the observed behavioral phenomena provides a common shared language that can define core concepts of insight into the "mysteries" of "why we relate the way we do" to the world and each other. Repeated insights into a current multitude of relational crises can eventually afford wisdom and societal changes apt to contain or even divert the current crises.

In conclusion to this brief written contribution, we can state that identifying a common basis of knowledge in psychology between areas of study, between scientists and professionals, may require abandoning the naturalistic science methodology in favor of cultivating a science of participatory observations and learning. We can achieve

this through constant attention to the experience of the relationship that the objects of psychological study have with aspects of themselves, as well as to the experience of the relationship with others in their shared context of intersubjective significance. The meta-theoretical concepts that we can derive from studying relationships can ultimately inform the idiosyncrasies and peculiarities of each relational experience, create a recursive dynamic of complexification of learning between the empirical observation and the abstract theorization.

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Beyond Compartmentalization: Generalizing Clinical Knowledge in Psychology

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Abstract

I expand the efforts to overcome compartmentalization of clinical psychology by reversing the notion of causality to that of resistance, and specify the structure of such resistance. Clinical practices produce psychological knowledge of general kind that leads to the adoption of the basic world view of idiographic science as the basic framework for systemic analysis of generic cases and thus feeds forward to further improvement of the clinical practices. Three directions for the future are outlined: clinical psychology builds on the systemic efforts of idiographic science, used historically structured non-random sampling of lived-through experiences, and situates its generalized knowledge within life-course developmental perspectives,

Keywords: measurement, idiographic science, sampling, generalization, resistance.

The basic epistemological weakness of clinical psychology is its self-identity as an "applied field". I am not here talking of clinical

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practice – this will necessarily be applied to deal with concrete cases. I have in mind the meta-reflection – the practice of contemplating *about* the clinical practice. It is in this latter intellectual gymnastic exercise where compartmentalization is born. Artificial borders are created here between practice and theory, and between different disciplines. As a result – the borders render some epistemologically legitimate questions seemingly absurd, e.g. "what is the role of astrophysics in psychotherapy?".

Salvatore and colleagues (2022) have created a powerful manifesto against compartmentalization in, and of, psychology. Here I will build upon one of the pillars they outlined for the future – *proposing and testing integrated theory-based interventions* (p. 29). Proposing a theory starts from the basic axioms – vision of the world that guides our methodology (Branco and Valsiner, 1997). I propose that the *basic process of resistance* be the axiomatic starting grounds for any theory of the human psyche. This lifts the primary focus in theory construction from causality – assumed to be central since Aristotle – to that of *systemic mutuality* (Figure 1).

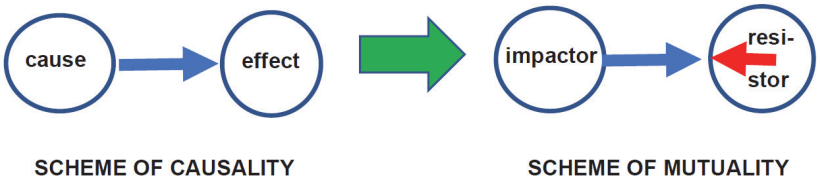

Figure 1. Axiomatic change from causality to resistance

The scheme of systemic mutuality entails the reversal of the "arrow of causality" – treating the object of assumed causal impacts as an active resister and re-director of the efforts to impact it. Systemic mutuality is a feature of the living systems – described well in the end of the 18th century (Schelling, 1799) but not implemented in the theoretical schemes of psychology. Its general structure is depicted in Figure 2.

The crucial feature of the structure of systemic mutuality is the counter-impact in the form of the block that either eliminates or redirects the efforts of the impactor on the border of the contact. The most universal biological example is the work of the immune system

that blocks the attacks by viruses once geared (e.g. vaccinated) towards doing so. Most importantly, the variety of possible ways of blocking becomes important in Figure 2 – not only "explicit killing" of the incoming impactor efforts but their neutralizing re-direction becomes the prominent way of resistance. Neutralization can be of two forms – *symbolic distancing* (the impact becomes signified *outside* of the existential sphere of the resistor) and *decaying abandonment* (ignoring the impact).

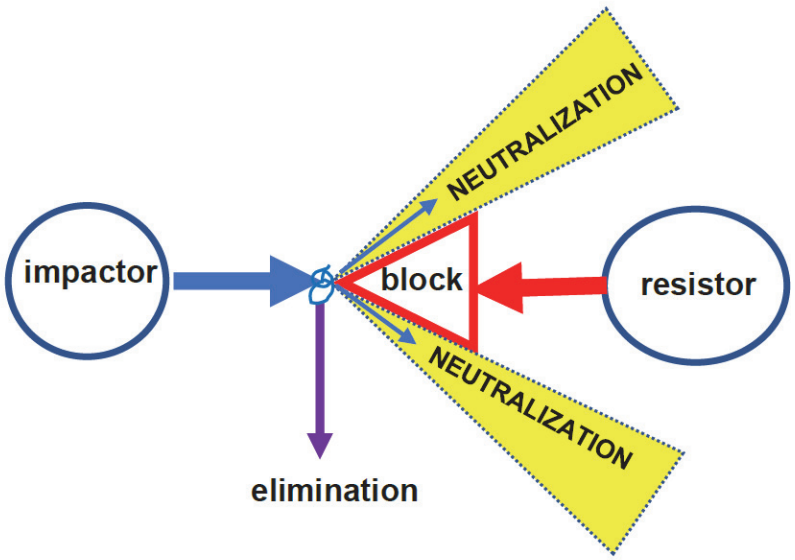

Figure 2. The structure of the resisting process.

The processes of neutralization lead to the replacement of the "causal arrows" by systems of catalysis (Cabell and Valsiner, 2014, Valsiner, 2019) and lead to the generalized notion of *Gegenstand* (Valsiner, 2021) that unifies the knowledge bases of the social sciences. Instead of direct impacts we think in terms of actively counteracted encounters of resistance (Chaudhary *et al.*, 2017). Such resistance is present both in acting persons – clinician or researcher on the one hand, and client or research participant on the other.

Resistance of the Researcher

Research is not a glorious walk to discovery of new knowledge, but a torturous climbing the difficult to reach the Peak of Knowledge that remains always on its next horizon. The necessary activities of the researcher often involve action demands that from the perspective of personal comfort or ethical standards belong to the border zone of psychologically possible for the researcher. While in clinical psychology we need not come across such scenarios too often (given the pre-defence by general ethical standards), the situation is quite different in anthropology where the researcher studies phenomena vastly different from one's own mores. The Hungarian-born American anthropologist George Devereux described his own fieldwork among the Sedang:

> The Sedang castrate boars with a sharp bamboo sliver and not with an iron knife, lest the spirits should assume that it is about to be sacrificed to them. Since the Sedang are callous in their treatment of animals and sometimes castrate dogs simply for the 'fun' of it, I did not look forward to having to witness the clumsy gelding of a young boar. Since I was supposed to record all techniques accurately, the next time a boar was slaughtered, I therefore asked a Sedang to castrate the carcass exactly the way he would castrate a live boar. The arrangement allowed me to make more accurate observations than if I had been obliged to take notes while being distracted – and distressed – by the squeals and struggles of a live boar. It may be objected, of course, that this subterfuge prevented me from observing also the psychologically significant reactions of the castrator. I took care of this matter by selecting for this task an excellent mimic, who, I am sure, displayed exactly the emotions a Sedang would display while castrating a live boar (Devereux, 1967, p. 86).

The researcher here can be claimed to be "cheating" – yet the feeling of comfort in the depiction of technical details required from the demand for anthropological objectivity might rehabilitate this act of artificiality of data collection. It can be viewed as an act of fine-tuning of one's procedure to distance oneself from the disturbing peripheral features of the ritual.

Resistance within the *psyche* of a patient

Why do people come to therapists? Why do they trust their innermost feelings to the minds of strangers to whom they pay fees? Even when encountering a therapist the person is involved in some form of resistance to one's own psychological problems which might get further suggestions for resisting to oneself.

Pierre Janet reported some decades ago a case where resistance was reported in the personal ideational domain of a psychiatric patient. Janet's 49-year old male patient reflected upon his self-inhibited intramental processes:

> I cannot…perform a single new activity without representing it to myself that it is going to entail diabolical consequences. If I buy new shirts it seems as if I am preparing for the assassination of my two children. If I rent an apartment it is only in order that I may place under the big entrance door the coffin of my wife where it will rest very nicely; I have selected this apartment (it would seem) only because of the convenience which this entrance way presents for the coffin of my wife. If I open this book it is with the idea that I am preparing a cataclysm which will involve the whole city of Paris. All this frightens me so that I take back my recent purchase of shirts with the excuse that they do not fit; I give up the apartment, and I close the book. (Janet, 1921, pp. 153-154)

Note that the reported processes of semiotic mediation – signifying decisions undertaken to make them meaningful – are by themselves ordinary, while the specific meanings that fill in these processes are pathological. The resistance to the invented consequences of the imagined futures are again perfectly adequate acts of self-inhibition. The action sequence that begins through ordinary creation of acts made meaningful enters into pathological ideation that the person oneself manages to inhibit. Resistance inhibits the growth of pathological ideation.

Resistance of a discipline

The processes of well-established resistances also operate at the collective level. This is the mechanism for creating inter-disciplinary

compartmentalization. Instant value decision "this is anthropological, not really psychological" as applied to submitted articles to an *inter*-disciplinary journal illustrate such borders set up in the educated professional minds.

To test this claim let me perform here a concrete test on the reader. I make one major proposition for changing a particular part of psychology curriculae Worldwide, and would like you all to concentrate on your first thoughts after reading the proposition. The proposition is:

> *"Let us eliminate the teaching of statistics from all curriculae of psychology, and replace it by teaching of embryology".*

My expectation is that the reader finds such suggestion surprising, and at least uncomfortable, if not outrightly annoying and "wrong". As the sacred role of statistics in granting objectivity has been trained into the minds of psychologists over the last century the use of statistics is a sign of "doing science". Why then such preposterous proposition? Embryology, in contrast, belongs as a sub-discipline to biological sciences that has no connection to the human *psyche*.

While speaking from the perspective of social institution of psychology as a discipline this dismissal of the proposition seems perfectly fitting. Yet if we consider the history of psychology as emerging science more thoroughly (Klempe, 2020, Valsiner, 2012), we may discover that the reliance on statistics is a 20th century applied psychology initiative that was built upon the 19th century world view of glorification of the "average citizen" in European political social discourses (Porter, 1992, 1994). Statistics was invented as a branch of applied mathematics under the pressures of political rather than scientific demands. Its prominence in psychology crawled into the discipline via institutional rather than epistemological routes (Gigerenzer *et al.*, 1989, Toomela and Valsiner, 2010). It is a technical tool – similar to newer inventions of helpful organizing devices such as Excel spreadsheets or Alexa. The latter are undoubtedly helpful in organizing business and daily life, but to turn them into the cornerstone of science might still be far beyond our imagination.

In contrast – embryology is a field that studies emerging and transforming forms. Its roots in early 19th century *Naturforschung* made it necessary to look at general principles of changing Gestalts in their

moves to the shape of the adult organism. As such, its generalized ways of thinking about phenomena – wholistic and transformational – fit for the phenomena of psychology where both the interior and exterior ("behavior") of the active person is of some organized form that undergoes transformation during development and is hoped to do the same through repeated visits to the consulting room of a therapist. Wouldn't this be closer to the needs of practice of clinical psychology?

So--what is the role of astrophysics in psychotherapy?

Let me return here seriously to the question posed in the beginning of this article that up there could have been dismissed as a joke. It is far from that. Celestial moving objects – galaxies, asteroids, comets, etc. – have features similar to our living objects on Earth. They have periodicity of appearance near the Sun – some comets may take two centuries for that which obviously limits the options of empirical data collection. As the comets approach the Sun their tails become increasingly visible to astronomers – somewhat similarly to the availability of some stated psychological problems as the client enters the psychotherapist's consulting room. Galaxies go through life courses from emergence to their demise. The dynamic macro-cosmos has clear parallels with our psychological micro-cosmos.

Conclusion: Radical reconstruction of psychology as theoretically based practice

Compartmentalization can be overcome by generalization – followed by re-contextualization of the generalized principles into a local context. It is through such act of "jumping over" the existing divisions between disciplines that clinical practice can gain prominence. This is the example of *vertical transfer* of knowledge from one specific field through generalization of abstract principles, leading to "landing" of the generalized principles in a different research field. In this way we can learn from astrophysicists studying the birth and development of galaxies – generalizing the basic structure of developmental processes – and bring the generalizations to a far-away field of human

development or psychotherapy. The lateral transfer, in contrast, would entail direct carry-over of empirical practices from one field into another. An example of absurd kind would be the establishment of "astrophysical psychotherapy". Such far-off lateral transfer is obviously absurd – yet in psychology we observe examples of closer similar transfers (e.g., cognitive neuroscience, evolutionary psychology) that struggle for finding the unifying central organization and fight about the borders between the fields. It is abductive – rather than inductive – generalization that leads science in its advancement (Märtsin and Samuel, 2022).

Let me outline the scenario of innovation in clinical psychology that comes via the vertical transfer of general principles. Some of these already have been used in the history of clinical practices – and forgotten due to the pressures from extra-clinical and extra-scientific domains.

First of all – **all clinical practice is based on generalized science of idiographic kind**. The fact that clinical psychology practice is based on individual systems that need treatment (persons, couples, families) is obvious. This has been the case over centuries. Interestingly the generalized scientific support for such practices began its existence in 2004 with Peter Molenaar's *Manifesto* (Molenaar, 2004). In the following two decades idiographic science has developed in various directions – yet always emphasizing the systemic organization of the individual case under investigation. Building up this general abstract knowledge base has not been easy (Salvatore and Valsiner, 2022). Notably idiographic here means – generalization from the particular system that provides us understanding of universal kind (i.e. nomothetic knowledge). Here the idiographic starting point leads to nomothetic generalization based on the systemic organization of any particular case (Di Nuovo, 2022; Valsiner, 2015, 2016). The best example of classic generalization based on a single case is Ivan P. Pavlov's discovery of the conditional reflex on the basis of a single dog (Valsiner, 2022) that is transferrable not only to all dogs of the World, but to all species which possess nervous system.

Secondly, **strategies of clinical psychology are to be free from ideologies of samples-based selection of phenomena and the idealized value of "random sampling**". Instead, clinical practices over centuries have practiced case-based selection of treatable cases (based

on anamneses). Yet it is only in the 21st century that the oversights of "random" (=non-systemic) selection of cases have been proven (Valsiner and Sato, 2006). The Historically Structured Selection (HSS) of cases builds on the sampling of previous life events that are relevant for the current investigation.

Furthermore, the non-ergodic nature of all psychological phenomena renders the use of inter-individual (in-sample) variability useless for the study of intra-individual (idiographic) cases. Finally – psychological measurement traditions have since 19th century added a projective insertion of the "measures" into the minds of the research participants that are not substantiated (Michell, 1999). Finding out that a person's "introversion score" is high (external responses summed up to the "score"--relative to the sample average, i.e. inter-individual comparison) is habitually projected into the person who produced these responses, adding the assumption of causal power to the constructed characteristic "introversion". Thus measured characteristic acquires intra-individual (temporal) causal ideation and is used to explain the shyness of the person during the next cocktail party. Such projected results of "measurement" lead both the clinical practice and science equally astray.

Finally – **clinical psychology becomes life-course developmental psychology** if it builds on the continuity of the personal strivings over time (Zittoun, Cabra, Pedersen and Hawlina, 2022). This is facilitated by new methodological approaches (e.g. TEA – Sato and Fukuyama, 2022) that treat the psychological insights into events that happened at the same focus of relevance as those that could have happened (but did not).

These three alleys of intellectual advancement would eliminate the seemingly uncrossable abyss between clinical practices and psychological science – the latter becoming transformed into a new form.

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On the quest for disciplinary unity and the virtues of open concepts

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Abstract

One key strategy for unifying the discipline of psychology is to develop a meta-theoretical framework through the advancement of core concepts. Rather than having these be strictly defined from the outset, this commentary argues for the utility of open-ended concepts for scientific advancement. This is illustrated with a brief historical review and current status of *Prägnanz*, *assimiliation-accommodation, schema, liminality* and *mediation*, which also show the difficulties on finding core concepts for psychology as a whole. Open-ended concepts may be useful here in that they can help to bring together converging lines of research from different approaches within psychology. Finally, a case is made for *mediation* as a core concept that is currently converging with notions of extended and distributed cognition.

Keywords: core concepts, disciplinary unity, mediation, social representations, schema.

"*It is the dilemma of psychology to deal as a natural science with an object that creates history*"
(Boesch, 1971, p. 9)

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Psychology is an awkward science situated between the natural and social sciences. On the one hand, it has to be consistent with the findings of biology and neurology, while on the other, its phenomenon overlaps to a high degree with other social and cultural sciences. When psychology emerged as a discipline in the 19th century, debates raged over the proper object and methods for psychology. Toward the end of the century, Wundt (1890/2009) attempted a synthesis of studying phenomena from the bottom up (from elements) and top-down (from wholes). In his *Outlines*, the discipline was to be divided between the study of lower (basic physiological processes) and higher (social-cultural) psychological processes, each with its own objects (i.e., consciousness and cultural patterns) and methods (i.e., experiments, and cultural comparison and interpretation). Ultimately, he failed to provide a satisfactory meeting point for the two branches, no one followed his unification of the discipline and others repudiated the limitations he placed on the natural science model (Danziger, 1990).

In contrast to Wundt's strategy of a philosophically leaning discipline, Salvatore and colleagues (2022) emphasize the need for not only general, abstract and well-defined scientific concepts but also grounding of these within different contexts of professional practice. In other words, they strive for unity in diversity of psychological research and intervention, accomplished through the building of a theoretical framework that touches down in the many contexts in which humans operate, thrive and suffer. They suggest for one the construction of hierarchies of explanatory principles with a meta-theorical framework at the top which is abstract and general. This in turn embeds different increasingly more concrete and specific theoretical models, until one reaches specific contexts of intervention. Core concepts sit high on the hierarchy and ground mid and short range theories. In this context, they mention efforts to reconstruct psychoanalytic theory, such as Riolo and colleagues' (2021) proposal to identify basic axioms, general theory, observational theories and operational theories.

In what follows, I would like to nuance the notion of unambiguously defined concepts, which is one (of three) strategies Salvatore and colleagues suggest in order to unify the discipline. While recognizing the value of the striving for more clearly defined concepts, I will argue that open, suggestive and future-oriented concepts also have an important role to play in scientific advancement. It is not only the

accumulation of "errors" in a theoretical approach that leads to scientific breakthroughs, as Thomas Kuhn (1962) famously argued, but also a surplus of new truths about a phenomenon that widens our view of it and an adequate theory needs to take account of (Moscovici, 1966). Moscovici (1976/2008) himself proposed "social representations" as an open-ended concept that would provide a framework for a broad study of culture, communication and mentalities in contemporary society, and as a counterpoint to more limited cognitive and individualistic theories in psychology. In this way, it can be advantageous to start with wide but diffuse concepts that nonetheless open-up the discipline to a broader view of the human condition.

Salvatore and colleagues (2022) give a number of examples of abstract, as opposed to empirically derived, concepts that are core concepts within their respective approaches. They mention *Prägnanz* in Gestalt theory (tendency toward "good form"), *assimilation-accommodation* in Piaget, *mediation* in Vygotsky, *schema* in Neisser, and *liminality* in Stenner. Two other important features of these core concepts are: First, they are removed from commonsense usage (unlike mind, consciousness, memory and intelligence). This allows them to operate more directly within a meta-theoretical framework with less mixing with everyday associations, but at the same time further removes them from applied contexts. Second, these concepts are inherently open-ended rather than clearly defined, closed concepts. They are open-ended in the sense of 1) not being strictly defined from the outset but sensitizing us to new truths, 2) highlighting the complexity of phenomenon not yet clearly understood, and as such 3) setting a programme for research into the future. This can be compared to Polanyi's (1962) idea that a new scientific theory is accompanied by a new vision of reality that is both more and less than knowledge: less because they are still a guess and more because they anticipate things yet unknown and at present inconceivable.

By briefly reviewing the history and status of these core concepts we can highlight the importance of open-ended concepts for theoretical advance and the unification of knowledge. At the same time, it will highlight some limitations and the improbability of using them and others to unify the discipline. Instead, I will argue that different research approaches should aim to build and articulate more general theoretical frameworks through open core concepts, which may converge

with other attempts (as has recently happened between socio-cultural psychology and new trends in cognitive psychology, as I will discuss below).

The notion of *Prägnanz* or the idea that perceptual forms would tend towards regularity, symmetry and simplicity, was actively and critically discussed, researched and applied to new areas, such as memory, in the 1940s and 1950s (Wagoner, 2017a). However, results were inconclusive (Riley, 1962) and the concept fell out of favour or at least was not actively researched. Part of the problem may have been that it did not easily translate beyond perceptual research (though notions like "closure" have been used to describe for example relationships, even in everyday language). The other issue was that the concept remained tightly linked to Gestalt theory and did not find a permanent home in other disciplinary approaches. This shows that concepts must be inherently extendable to other domains (as Salvatore *et al.* [2022] describe has happened to e.g. attachment theory).

The concept of schema has also had its ups and downs. It was advanced in a sketchy manner in the 1920s and 30s by figures such as Bartlett and Piaget, only to be temporarily abandoned and then picked up again in the late 1960s by the emerging subdiscipline of cognitive psychology, where it remains a central concept (Wagoner, 2017b). In its original form, it described how all human experience takes form through an organized setting or active developing pattern, built up over a person's lifetime. While its meaning remains somewhat ambiguous, it has been used in a vast variety of different contexts and is a good contender for a concept to unify research on such processes as perception, memory, the self, educational processes, and more. One problem with the way that it has been adopted, however, is that it has tended to be treated as a static knowledge structure in the head, which is a far cry from its origins as an embodied, dynamic, temporal and social concept (Wagoner, 2013). In this way it was detached from the original set of basic axioms and reattached to a new set, which radically changed the concept in the process. It continues to be widely used today but in a diversity of ways, varying according to the basic assumptions of the disciplinary approach in question.

The other concepts mentioned have been more consistently dynamic and processual in their basic assumptions and thus might offer more fruitful conceptual foundations moving forward. Assimilation and

accommodation was the core concept of Piaget's theory and remains central to conceptual efforts in psychology. Even Moscovici's (1984) theory of social representations (already mentioned above) uses concepts that parallel them – namely *anchoring* and *objectification* – but in a wider context than Piaget had done, who had focused mainly on children's cognitive development. Anchoring is used to explore how new scientific ideas are made sense of through pre-existing commonsense knowledge, while objectification highlights how this new knowledge is transformed into concrete images. Like Piaget, Moscovici explicitly aimed to develop a "genetic" approach (a basic axiom), focusing on the qualitative emergence of a phenomenon through time.

Liminality is also an inherently processual concept that thematizes individual experience within a societal nexus. It was first introduced by van Gennep's (1960) in his classic book *Rites of Passage* to explore the rituals that accompany the transitional state between social positions. It has a rich history in anthropology following Victor Turner's (1967) appropriation of the concept, but has only recently found its way into a branch of psychology (for a range of applications see Stenner, Greco & Motzkau, 2017; Wagoner and Zittoun, 2021). Although a core concept in anthropology, it is unlikely to gain that status in psychology given the different assumptions and questions of the two discipline and competing concepts found in both.

Finally, the notion of mediation has a distinguished pedigree in both philosophy and psychology. It was already an important feature of Wundt's (1890/2009) unification of the discipline in that all higher psychological processes were seen to be mediated by culture. As cultural products are variable across time and space, we should expect higher psychological processes to be so as well. The concept clearly works to bridge the individual and collective levels of analysis, showing how culture shapes mind and mind shapes culture. At the same time, the concept on its own does not specify how these operate nor its variable effects. That is precisely the task for further conceptual and empirical work – for example, research has explored what happens when so called "natural" and "cultural" lines of development intertwine in ontogeny (Vygotsky, 1987) and human evolution (Donald, 1991), mediation's "process structure" (Valsiner, 2001) and the use and effect of various forms of mediators in educational or clinical practice.

Thus, I would argue the concept of mediation is a good contender for a truly unifying core concept (recognizing that I am biased in this assessment, given my own position as a sociocultural psychologist). First, it has a solid history of discussions in psychology and philosophy to build on. Second, it is removed from commonsense usage and can thus be more easily situated purely in relation to other concepts within a theoretical framework. Third, it aims to explore the intersection between biology and culture in human functioning, thus bringing together the two sides of the discipline. Immediate biological reactions are ruptured through the mediation of culture, which creates distance between person and environment, and opens up a space possibility. Fourth, it functions as a connecting link between individuals and society. Mediators are social in origin, embedded in the history of a group. When individuals internalize them, psyches are transformed but in different ways for different people. This is because they enter into unique psychological systems. The analytic focus thus centers on this dialectical tension, exploring how culture and minds mutually constitution each other (Shweder, 1991). Fifth, it is inherently processual in its basic assumptions: mediators are always mediat*ing* some activity. We need to explore the full arc of this movement, including its history, contextual trigger, unfolding, outcome and generalization to new situations (see e.g., Valsiner, 2012). Sixth, while being abstract, it can readily be applied to different practical fields, and is already currently popular within educational, work and even therapy research. Seventh, it is an open-ended concept that can and has been developed in different directions and in a variety of contexts. Eighth, there is a convergence of conceptualization, interests and research findings between sociocultural psychology's use of mediation and cognitive psychology's growing concern with extended and distributed cognition (and more recently "4E cognition" – see e.g., Newen, De Bruin & Gallagher, 2020). Identifying separate lines of research that seem to be converging is a future oriented task, which is likely to be more successful and enduring than simply stating that something should be a core concept and defined in a certain strict way. Ultimately, concepts need to be shown to be useful in making progress on specific research concerns as well as the more general concern of constructing a unified discipline that can address the complexities of being human in ever-changing world.

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