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Participatory Sense Making in Jazz Performance: Agents' Expressive Alignment

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ABSTRACT

Relationships between musicians in Jazz performance can be understood as autonomous (turn-taking) *versus* simultaneous (playing joint), both assumed as social interactions that take place as to create meaning in a participatory way. To participate, in music performance, requires expressive alignment, in order to share the act of producing and perceiving sound and movement in an embodied-inter(en)acted phenomenological experience. In such context, interaction is assumed as an expressive exchange of meanings. In this work we study a trio jazz performance from an inter(en)acted approach, applying a methodological design that combines objective/statistical measures, and subjective/phenomenological data. An experiment that tested different conditions of turn-taking and/or joint playing of a Jazz standard was conducted in a recording studio session. All the performances were registered through audio/video media, and motion capture technology. In addition, in-depth interviews before playing/after recordings were conducted. Time series data related to sound and movement were analysed to study features of expressive alignment, accounting for descriptors of participatory sense-making. A Sense Granger measure was developed from Granger Causality measures in order to describe expressive alignment between-and-within performers. Significant differences were found in situations of turn-taking, and simultaneous playing between conditions. Results show that, beyond such differences, jazz musicians sustain interactional transactions based on their phenomenological experience of 'going together in time'. Sense Granger measures serve to account for the ways expressive alignment evolves in time, providing significant cues that help understanding participatory sense making in jazz performance.

I. INTRODUCTION

Role-interaction between musicians in jazz ensembles highlights different ways of sharing movement and sound in time during performance. When musicians play a jazz standard, they play together (J), or take turns (TT) within-and-or-between phrases during improvisation. These types of interaction have been described in the field of the ethnomusicology of jazz using the 'conversation' metaphor (Monson 1996, p. 73), unfolded throughout a mutual 'giving and receiving' (Berliner 1994, p. 348). From an enactive perspective, though, in all these instances the improvisers display expressive alignments (Leman, 2016), accounting for a dialogical dynamics that might be linked to Participatory Sense-Making (PSM) (De Jaegher & Di Paolo, 2007). De Jaegher & Di Paolo (2007) elaborate on the concept of PSM to focus on the inter-individual level in which people participate with each other along a moving present. Social interaction can be enacted (i) through the elaboration of an individual sense -affected by coordination dynamics-; and (ii) as a shared sense, that emerges from the joint action as a whole. The apparent opposition between the individual and the social enactive dimensions occurs, instead, in the framework of a continuum that ranges from the autonomy of the human interactors to the process of emergent interaction as a whole. Torrance and Froese (2011) claim that PSM in jazz improvisation becomes evident in the way an individual action is intertwined with the emergence of the group. Improvisation is, therefore, an emergent group product that is co-created spontaneously. In line both with Torrance and Froese (2011), and Schiavio (2014) we assume PSM in music as an ongoing, co-constructive process that emerges from the phenomenological inter(en)acted experience of playing together in time. While playing together, be it that musicians take turns or improvise simultaneously through the different sections of a Jazz standard, they align expressively with the music they create (Leman, 2016). Expressive alignment is a method of enaction that allows musicians to coordinate their own states with the musical patterns with which they are interacting. In this paper we wonder whether expressive alignment varies according to what section the improvisers play in the standard (theme or improvisation), and also whether alignment varies according to the role they play during performance (turn-taking (TT) or joint (J)). We apply statistical measures to the sound-kinetic moving forms musicians produce when they play during music improvisation, with the aim of exploring features of expressive alignment inherent to PSM.

II. AIMS

This paper aims at exploring the flow of mutual influences in the sound-and-movement dynamical system displayed by the musicians during improvisation exchanges. In so doing, the musician's expressive alignment is characterized in order to account for feature-descriptions of interactional PSM in Jazz improvisation. The musicians' phenomenological experience is also tested as to find verbal cues of the mutual influences that unfold in PSM.

III. METHOD

A. Participants

1 *ad hoc* professional jazz trio (2 tenor saxophones, 1 piano).

B. Stimuli

Jazz Standard "There is no greater love" (I. Jones-M. Symes).

C. Procedure and Design

The experiment had two parts. In Part 1, the trio performed the standard in 4 conditions: c1: Turn Taking - Main Theme (TT-Th); c2: Turn Taking - Improvisation (TT-I); c3: Joint Action – Improvisation (J-I), and c4: Joint Action – Theme (J-

Th). The formal structure of the standard in all conditions was AABA. In Part 2, individual in-depth qualitative phenomenological interviews were administered to the musicians immediately after completion of Part 1. The interview's design included questions about intragroup interaction experience related both to communication and attention to sound production, and to movement of the other saxophonist.

The interview was conducted by the researchers, adopting an empathic attitude with the participant. A second person perspective was assumed, in order to allow for the emergence of the participant's self-experience description (Høffding & Martiny, 2015).

D. Apparatus and Setup

Musicians' behaviour was captured and recorded with an Optitrack motion capture system composed of 12 infrared cameras. For each saxophonist 13 reflective markers were placed on the musicians' bodies; 4 further markers were placed on the pianist head; 3 more markers were located on each saxophone, totalizing 6; finally, 1 further marker was placed in-between the trio, as to set a relative spatial centre to allow further inter musicians' analysis. In the present study, we inform results corresponding to data extracted from the saxophones markers centroid, and from the saxophonists' heads. Although interactional mappings between musicians include the pianist, in order to compare sound-kinetic data originated in similar "embodied sources", taken from body postures related to the same instrument -as to bring movement modes that allow the most reliable comparisons- pianist's data were not taken into account. The only exception was the pianist's beat extraction data that were used to organize the segmentation of the observation windows. The trio performance was also audio-recorded as to extract the audio data time series that were analysed. Each saxophone was recorded on separate audio channels.

E. Data Processing

In Part 1 four time-series data, two related to movement (1a; 1b), and two related to sound (2a; 2b) were processed. (1a), and (1b) measured the Euclidean distance between the sax centroid and the saxophonist head and a spatial reference centre, respectively; (2a), and (2b) measured respectively the amplitude envelope (algorithm: mirenvelope) (Lartillot, 2008), and the fundamental frequencies of the audio signal recorded in the session (algorithm: vamp plugin melody) (Salamon, 2012).

F. Data Suitability, Pre-processing and Analysis

The Data consisted of 8 sets of time series, 4 sets related to each saxophonist. Each of which represents many observations of the variable over time. The variables were recorded in parallel, so that $t = tn$ in time series 1, corresponds to $t = tn$ in all other series. The number of observations significantly exceeds the number of variables as recommended in Seth (2010).

Prior to Granger Causality (GC) estimation, time-series data were demeaned, detrended, normalized to z-scores and windowed into overlapping windows (1 beat temporal sliding window, 7 beats overlapping (average beat = 37ms. / average window = 296 ms)). Granger causality inference was carried out at each window to ensure covariance stationarity. GC was estimated using the GGCA toolbox (Seth, 2010).

We measured the Conditional Granger Causality between the two musicians' time-aligned series, as a way to estimate inter-musicians' communicational situations, and to infer Participatory Sense Making cues that were useful to guide Part 2 further analyses.

Based on GGCA, we achieved a further measure, named Sense Granger (SG), developped as to test the temporal evolving of significant G-Causality observations, collected from the correlations between the 4 temporal data series. The cca_granger_regress function (GGCA Toolbox) returns significant interactions between variables. The statistically significant set of G-causality interactions was recovered by using a Bonferroni correction. A 0.005 probability threshold was applied to control multiple comparisons. Sense Granger corresponds to the sum of the significant G-causality interactions, weighted by all the observational windows and accounting for the overlap instances. SG depends on the number of times each musician significantly exerts his influence, or exchanges information on each other, rather than on the magnitude of these processes.

In Part 2, a continuous verbal analysis of responses was run as to derive categories that explain musicians' SM experience. Interviews were transcribed and analysed using QSR NVIVO 8 software. A qualitative analysis method was used as to (i) codify relevant categories (nodes) from words taken from the text, and from concepts related to the theoretical framework underlying this study; (ii) identify recurrent descriptions of the phenomenological experience that employed metaphorical language; (iii) organize metaphors in two types of general descriptions of participants' experience: (1) dynamics, and (2) statics; and (iv) establish links between the different metaphors as to know which of them was the most pervasive in the statements along all the interviews. Also, which of them described best the musicians inter(en)active experience of playing together.

IV. RESULTS

A. Part 1

The dataset (4 conditions x 2 participants x 4 time series x 483 windows) totalized 15.456 sets. An N-way Analysis of Variance, with Sense Granger Flow as dependent variable, and 3 Factors (Sax (1, 2), Musicians Interaction (TT, J), and Standard (Theme (Th), Improvisation (I)), found significant differences for factors Sax ($F=11.08$, $p< 0.001$), and Musicians Interaction ($F=58.9$, $p< 0.001$). Factor Standard was not significant. As to interactions between factors, Sax*Musicians Interaction was significant ($F=10.89$, $p< 0.001$). Standard*Musicians Interaction was also significant ($F= 89.63$, $p < 0.001$). Finally, interaction Sax*Standard was not significant. This indicates that musicians make sense differently when they play Thematic sections vs Improvisation sections, and when they play Taking Turns, vs playing Joint.

Sense Granger analyses identified peak areas that correspond to moments where expressive alignment between musicians is maximum in movement, pitch frequency, and dynamics.

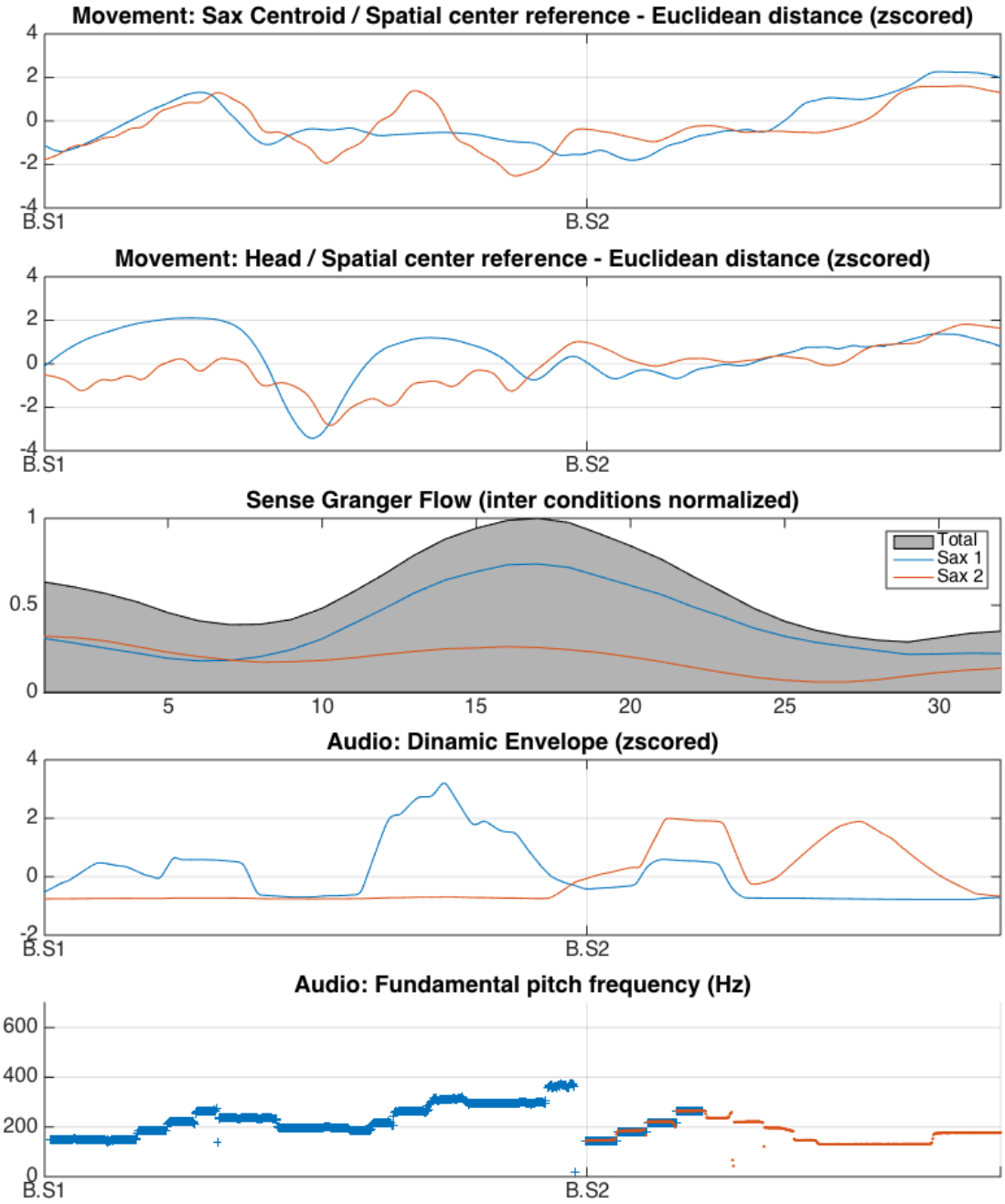

Figure 1. Condition 1, section B (Turn Taking /Main theme). Subplot 1: Movement variable: Euclidean distance between Sax centroid and Spatial reference centre (z-scored). Subplot 2: Movement variable: Euclidean distance between Saxophonist's head and Spatial reference centre (z-scored). Subplot 3: Sense Granger Flow (normalized between all conditions). Subplot 4: Audio variable: Amplitude envelope (z-scored). Subplot 4: Audio variable: Fundamental frequencies (Hz).

In Figure 1, for example, Sense Granger peaks are located around TT areas. Audio-video observations show an increment on sensorimotor communication between musicians. Also, sound-kinetic information is transferred from the current player onto the player who is about to take the turn. In some cases, the increment of SG is linked to the sound production of the saxophonist who is finishing the turn. In others, SG peaks are related to the improviser who, while waiting to take the turn, is moving without making sounds: in those instances, the movement appears as central in the communication between performers. Thus, the emergence of imitative and expressive movements seems as to picture an ending/beginning kinetic 'narrative' in turn-taking locations. As to joint action, SG observations of saxophonists playing improvisation sections show, for example, recurrent short, imitative sound-kinetic inter(en)action patterns (Figure 2). Similar SG peaks located at specific structural points might account for the musicians' need of conveying musical structure and expressive intentions between each other during performance (Demos et al, 2014).

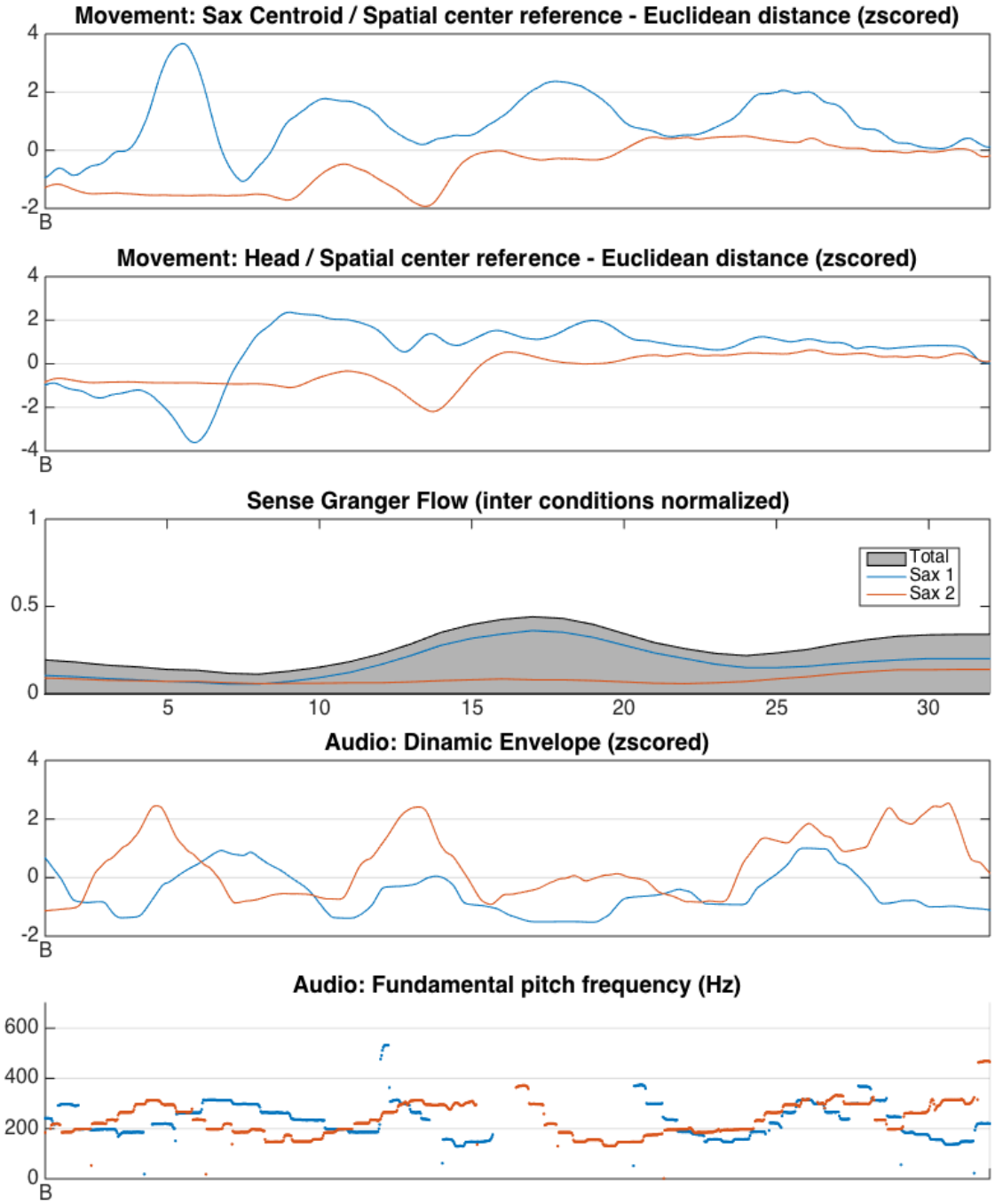

Figure 2. Condition 3, section B (Joint action / improvisation). Subplot 1: Movement variable: Euclidean distance between Sax centroid and Spatial reference centre (z-scored). Subplot 2: Movement variable: Euclidean distance between Saxophonist's head and Spatial reference centre (z-scored). Subplot 3: Sense Granger Flow (normalized between all conditions). Subplot 4: Audio variable: Amplitude envelope (z-scored). Subplot 4: Audio variable: Fundamental frequencies (Hz).

Therefore, in spite of the differences accounted for musicians' sense making between conditions, the identified sound-kinetic inter(en)action patterns of expressive alignment serve further communication, and performer-performer information transfer at turn-taking areas and/or improvisations sections.

B. Part 2

As to the interviews, musicians described their phenomenological interactive experience in terms of "going together". This metaphor serves to provide an account of the diversity of situations in which interaction is experienced: going together in time can involve playing separately or 'travelling' through the same places, pushing or drawing back,

carrying or being carried, going fighting or carrying it forward. However, TT and J playing were experienced differently. In the first case, "give and take" instances provided a strongest sense of being together in the music, even when they were not playing at the same time. On the other hand, playing simultaneously the same melody was mostly experienced as going separate, or "listen the other as environment"; the last statement might have described improvisation instances experienced as the by-product of the loss of the other saxophonist's agency in the sensed environmental complexity.

V. CONCLUSIONS

Jazz improvisation is a sociocultural practice of Participatory Sense Making. Results indicate that musicians experience performance as going together in time. Nevertheless, they appear to make sense differently whether they play Taking Turns compared to Joint playing. Expressive alignment, a feature that characterizes musicians inter-enaction, accounts for the ways sender and receiver engage dynamically in encoding-decoding perception-action alignment loops. In our study, Sense Granger was elaborated as an analytical tool capable of accounting for the ways expressive alignment evolves in time. While aligning expressively, musicians negotiate meanings by means of contingent (playing J) and/or autonomous goal-directed (TT) actions during performance. Significant Sense Granger was assumed to attests for features of Participatory Sense Making. In Taking Turns instances of apparent agents' autonomy, communication loops are sequential, while in Joint instances, communication loops are overlapped. These two contexts bring about different environments for PSM. Whether or not musicians are fully aware of such complexity in their phenomenological experience, the sound-kinetic outcomes of their joint and-or sequential autonomous actions provide significant cues that help understanding the meanings of PSM. At the same time, SG peaks located at located at music structural instances seem to convey formal meaning in PSM expressive alignment.

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