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Art as an interpretation of scientific data

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Abstract. In a society that is increasingly the victim of rapid thinking, and which in the not too distant future may be faced with the dangers of a machinistic drift, the relevant characteristics of humanity are being rediscovered. Humanity is also expressed in creativity, which is possible not only in art but also in scientific research. It is therefore essential to hybridise knowledge and to cross disciplines in order to maintain a process of knowledge that is truly human. Creativity must therefore permeate all contexts, enriching them and directing them towards innovation.

Key words. S+T+ARTS project, GRIN, Transdisciplinarity, Art, Data Analysis, Supercomputing

1. Introduction

If we perform a quick Internet search using the keywords ”art” and ”science,” we will receive countless results, hundreds of projects, initiatives, and reflections. There is no doubt that the relationship between the two disciplinary fields is incredibly rich and vibrant. However, many people feel that the relationship is not strong enough and still suffers from the rift that positivism and romanticism have caused, imprinting a separation between the two fields. This rift so deep that Snow, in 1959, sparked a heated debate on the subject following the publication of his ”The Two Cultures and the Scientific Revolution” (Snow 1959). In the text, as a sort of reaction to neo-idealism, Snow criticizes the snobbish position of humanism, which, neglecting the relationship with science, loses the richness of sharing.

The two cultures cannot live separately, as Primo Levi clearly saw. Neither the literary world nor the scientific world can suffice on their own:

> *”It would be a good thing if the writer did not live, I won’t say in an ivory tower, but in a duct, in a pipeline that starts from Dante and goes on infinitely. And he moves in this pipeline without ever seeing the world around him. If we live in a world permeated with technology and science, it is unwise to ignore it, also because Science, with a capital S, and Technology, with a capital T, are formidable sources of inspiration.”* (Levi & Belpoliti 1997)[1]

[1] “Sarebbe una buona cosa che lo scrittore non vivesse non dico in una torre d’avorio, ma in una condotta, in una tubazione che parte da Dante e arriva all’infinito. Ed egli si muove in questa tubazione senza mai vedere il mondo intorno a sé. Se viviamo in un mondo impregnato di tecnologia e scienza, è sconsigliabile ignorarlo, anche perché la Scienza,

> *"The history of technology shows that, when faced with new problems, scientific culture and precision are necessary but insufficient. Two other virtues are still needed: experience and inventive imagination. But in the profession of natural gas exploitation, which is very recent, experience does not expand through centuries and millennia [...] Experience requires trials and errors, but here there is no time to make mistakes and correct them, and imagination must prevail, which operates by leaps, in short times, through radical and rapid mutations."* (Levi 1985)[2]

The risks inherent in this imbalance have been countered, over time, by the numerous initiatives that populate the above-mentioned Internet query with answers. These include, since 2016, the S+T+ARTS project in which we, as CINECA[3], have participated as part of the GRIN initiative[4].

2. The GRIN S+T+ARTS Project

Since 2016, the European project S+T+ARTS has aimed to bring the relationship between art and science to centre stage by supporting art residencies based on the use of scientific data and close collaboration between artists and researchers. GRIN - Art-driven innovation for digital and green transition in European Regions, is a S+T+ARTS regional centre preparatory action that focuses specifically on the themes of digital and ecological transition, declined in various ways depending on the partners involved. CINECA and Kilowatt[5] are the partners of the Italian action in the Emilia-Romagna region. The specificities of Cineca oriented the call for the 3 regional artistic residencies towards a focus on meteoclimatic data, the concept of digital twins and supercomputing.

The call for artists for the Bologna - Emilia-Romagna cluster selected three artists: Salomé Bazin, with "Destination Earth. The Ocean's Breath," Calin Segal with "Tales from the Receding Edge," and Marco Barotti with "FUNGI - Symbiotic Harmonies," who respectively explore the interactions between Oceans and atmospheric events; the sea and the erosion of the Italian coastline; and the networks of mycorrhizal fungi and the plants with which they are in symbiosis[6].

During the meetings held to follow and support the three resident artists in Emilia-Romagna, in addition to Cineca internal experts, other research institutions, such as ISPRA[7], OGS[8], and CMCC[9], were involved.

In July at the Bologna Technopole, during the G7 meeting on Science and Technology, a preview of Calin Segal's installation, "Tales from the Receding Edge," had been presented (Fig. 1). The work was particularly suitable for the event, which hosted a session on the protection of the seas and the ocean and their biodiversity, as it explores the transformative power of coastal erosion, challenging our perception of permanence and our relationship with nature. Climate data have been extracted from MEDCORDEX[10]. The model used for the simulations is the French CNRM-RCSM4, from which marine current velocities (uos and vos) were taken for the oceanic component at 0.1-degree horizontal resolution using the RCP85 emission scenario; for the atmospheric compo-

con la S maiuscola, e la Tecnologia, con la T maiuscola, sono delle formidabili fonti d'ispirazione."

[2] "La storia della tecnologia dimostra, come davanti ai problemi nuovi, la cultura scientifica e la precisione sono necessarie ma insufficienti. Occorrono ancora due altre virtù, che sono l'esperienza e la fantasia inventiva, ma nel mestiere dello sfruttamento del gas naturale, che è molto recente, l'esperienza non si dilata attraverso i secoli e i millenni [...] All'esperienza sono necessarie le prove e gli errori, ma qui non c'è tempo di sbagliare e di correggersi, e deve prevalere la fantasia, che opera per salti, nei tempi brevi, attraverso mutazioni radicali e rapide."

[3] CINECA website

[4] GRIN website

[5] Kilowatt website

[6] Call for artists

[7] ISPRA website

[8] OGS website

[9] CMCC website

[10] MEDCORDEX website

Fig. 1. Tales from the Receding Edge, by Calin Segal, at G7 2024 meeting on Science and Technology.

nent, wind velocities were extracted at 0.44-degree resolution. The preview, held among specialists, was highly appreciated and offered positive confirmation of the art's ability to promote debate and reflection among spectators.

The final project exhibition, with all three installations and open to the public, was held at the Serre dei Giardini in Bologna from September 12 to 15, 2024.

3. The Perspective of a Data Analyst

In the collective imagination, the Data Analysts are the ones who, bent over a calculator, perform mathematical operations on numerical data and, when these numbers are many, they use a supercomputer! The same image is derived from formal definitions. The definition of data scientist taken from the Treccani online dictionary reads: "One who is an expert in the analysis and interpretation of significant amounts of computer data."

The data analyst's scientific world, his actions, are by common feeling as far removed as possible from the creative world of the artist. What is creative about adding, dividing, calculating averages and percentages? It all seems very sterile, aseptic, almost banal.

And yet even the Data Analyst's job is creative in its own way.

It is, for instance, when, starting from a data collection, they tell a story. The same data can also tell multiple stories, because they can be used to analyse different aspects of a phenomenon. Choosing the most appropriate algorithms for the databases available, selecting the truly important data, verifying their quality and consistency before applying an algorithm requires scientific sensitivity but also a creative vision of the information to be extracted. Because the data itself is not informative; it becomes so when it is transformed and synthesised. Only then is alchemy achieved, understood as 'unusual combination of elements, leading to an original and refined result or effect' (Treccani online dictionary, definition c).

The Data Analyst also shares with the artist a communicative approach. It is essential that the Data Analyst is empathetic in presenting the results, engaging the audience without scaring them with the complexity of the phenomena described or the results achieved in their research. The greatest satisfaction in presenting projects is seeing the emotion in the people in front, who perhaps discover something new or simply see something familiar from a new perspective, a connection, a correlation between situations or phenomena they had never noticed before. And being able to stir such reactions is something enormously exciting for the Data Analyst!

Another emotion that is often thought to be far removed from the world of the Data Analyst is wonder. Telling about wonder is not the pri-

N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable	N.	Variable
1	sample	31	Species count	61	VTX00281	91	VTX00398	121	VTX00163	151	VTX00229	181	VTX00204	211	VTX00128	241	MO-G69	271	VTX00175	301	MO-P4	331	VTX00407	361	LH-Ac01	391	TJ-GL4	421	VTX00447	451	VTX00408	481	VTX00251	511	JD-GL04
2	country	32	VTX00074	62	BS3	92	VTX00005	122	VTX00060	152	VTX00165	182	VTX00054	212	VTX00412	242	VTX00417	272	MO-G70	302	INTA-9	332	VTX00058	362	VTX00181	392	LH-GI05	422	VTX00098	452	VTX00217	482	VTX00044	512	VTX00427
3	site	33	VTX00423	63	VTX00358	93	VTX00342	123	VTX00100	153	VTX00130	183	VTX00215	213	MO-P2	243	TJ-GI8	273	VTX00287	303	DG8	333	VTX00174	363	VTX00404	393	VTX00269	423	LH-Ar03	453	VTX00436	483	VTX00285	513	VTX00275
4	ecosystem	34	VTX00199	64	VTX00245	94	VTX00247	124	VTX00311	154	VTX00125	184	VTX00103	214	LH-GI09	244	MO-G68	274	VTX00414	304	SK-C2	334	TJ-GL1	364	VTX00031	394	VTX00350	424	VTX00176	454	LH-Ar02	484	VTX00334	514	LH-Ac02
5	biome	35	VTX00160	65	VTX00213	95	VTX00105	125	VTX00015	155	VTX00076	185	VTX00422	215	GCL-2	245	VTX00122	275	MO-G64	305	VTX00368	335	GCL-8	365	VTX00284	395	SS-PG2	425	VTX00348	455	LH-Sc02	485	TJ-GL5	515	VTX00017
6	habitat	36	VTX00166	66	VTX00315	96	VTX00223	126	VTX00372	156	VTX00382	186	VTX00419	216	VTX00369	246	SS-G2	276	VTX00272	306	VTX00353	336	LH-GI08	366	VTX00182	396	VTX00102	426	LH-Sc01	456	MO-Ar4	486	DV4	516	TJ-AR
7	plot	37	VTX00049	67	VTX00014	97	VTX00067	127	VTX00063	157	SS-AR1	187	VTX00364	217	VTX00084	247	MO-G72	277	VTX00135	307	VTX00205	337	IS-GI2	367	LH-GI02	397	VTX00178	427	GCL-1	457	VTX00197	487	MO-Ar5	517	VTX00453
8	plot_latitude	38	VTX00193	68	VTX00056	98	VTX00069	128	VTX00242	158	VTX00444	188	VTX00051	218	VTX00030	248	MO-G65	278	VTX00335	308	VTX00107	338	VTX00377	368	VTX00383	398	VTX00189	428	MO-Ar10	458	MO-A9	488	INTA-10	518	VTX00294
9	plot_longitude	39	VTX00194	69	VTX00327	99	VTX00172	129	VTX00186	159	VTX00024	189	VTX00403	219	VTX00376	249	SS-G1	279	VTX00356	309	VTX00237	339	GCL-7	369	VTX00429	399	VTX00101	429	VTX00203	459	VTX00425	489	VTX00046	519	MO-S4
10	lat	40	VTX00142	70	VTX00345	100	VTX00140	130	VTX00053	160	KEK-CG2	190	TJ-PG1	220	VTX00083	250	VTX00087	280	VTX00340	310	VTX00309	340	IS-GI1	370	VTX00431	400	VTX00259	430	MO-Ac12	460	VTX00290	490	VTX00033	520	VTX00034
11	lon	41	VTX00113	71	VTX00362	101	VTX00187	131	VTX00349	161	VTX00446	191	VTX00238	221	VTX00400	251	VTX00395	281	VTX00402	311	VTX00218	341	LH-GI07	371	GCL-3	401	MO-G63	431	VTX00456	461	MO-Ar8	491	INTA-7	521	VTX00200
12	altitude	42	VTX00149	72	VTX00222	102	VTX00078	132	VTX00359	162	VTX00241	192	VTX00059	222	VTX00373	252	VTX00134	282	TJ-CL1	312	VTX00375	342	VTX00278	372	MO-G67	402	DG7	432	VTX00341	462	VTX00389	492	VTX00019	522	VTX00040
13	MDS1	43	VTX00305	73	VTX00123	103	VTX00156	133	VTX00112	163	VTX00228	193	VTX00256	223	IH1	253	VTX00211	283	VTX00319	313	VTX00209	343	IS-GI3	373	VTX00438	403	VTX00365	433	GCL-5	463	VTX00201	493	JD-GL01	523	MO-Ac13
14	MDS2	44	VTX00233	74	VTX00360	104	VTX00231	134	VTX00009	164	VTX00301	194	VTX00263	224	TJ-GL6	254	VTX00124	284	VTX00088	314	VTX00073	344	DG18	374	VTX00424	404	VTX00206	434	VTX00457	464	MO-G77	494	MO-GC3	524	LH-Ac03
15	MDS3	45	VTX00057	75	VTX00153	105	VTX00361	135	VTX00148	165	VTX00393	195	VTX00420	225	VTX00106	255	VTX00390	285	VTX00202	315	DG17	345	VTX00179	375	SK-C11	405	VTX00094	435	VTX00437	465	VTX00258	495	MO-A8	525	VTX00144
16	pHKCL	46	VTX00129	76	VTX00253	106	VTX00280	136	VTX00219	166	VTX00343	196	VTX00041	226	VTX00363	256	VTX00387	286	VTX00055	316	VTX00235	346	VTX00260	376	VTX00091	406	VTX00047	436	VTX00386	466	VTX00045	496	VTX00254		
17	P	47	VTX00143	77	VTX00092	107	VTX00072	137	VTX00080	167	VTX00239	197	VTX00111	227	VTX00268	257	VTX00089	287	VTX00326	317	MO-P3	347	VTX00426	377	DG12	407	VTX00048	437	VTX00440	467	VTX00454	497	MO-A10		
18	K	48	VTX00154	78	VTX00114	108	VTX00177	138	VTX00304	168	VTX00225	198	VTX00137	228	IS-Pg1	258	VTX00367	288	VTX00075	318	VTX00020	348	VTX00331	378	VTX00401	408	DG2	438	DG11	468	VTX00224	498	MO-Ar3		
19	Ca	49	VTX00117	79	VTX00085	109	VTX00338	139	VTX00001	169	VTX00347	199	DG10	229	IS-Ar1	259	VTX00291	289	VTX00118	319	DG6	349	KEX-G1	379	TJ-GL2	409	DG1	439	SK-C9	469	JD-GC06	499	DG3		
20	Mg	50	VTX00167	80	VTX00379	110	VTX00230	140	VTX00371	170	VTX00354	200	LH-Pg01	230	VTX00214	260	VTX00195	290	DG9	320	MO-G66	350	VTX00265	380	VTX00086	410	IS-CI1	440	VTX00336	470	VTX00416	500	GCL-6		
21	Cu	51	VTX00115	81	VTX00366	111	VTX00126	141	VTX00325	171	VTX00410	201	VTX00262	231	VTX00270	261	VTX00323	291	VTX00077	321	VTX00185	351	TJ-GL3	381	VTX00346	411	VTX00210	441	VTX00104	471	VTX00296	501	INTA-4		
22	Mn	52	VTX00234	82	VTX00399	112	VTX00276	142	VTX00061	172	VTX00121	202	VTX00397	232	LH-GI06	262	VTX00068	292	MO-G71	322	VTX00249	352	SS-PG3	382	VTX00131	412	VTX00257	442	VTX00337	472	VTX00246	502	INTA-6		
23	B	53	VTX00306	83	VTX00029	113	VTX00093	143	VTX00026	173	VTX00120	203	MO-G74	233	VTX00039	263	VTX00082	293	VTX00180	323	JD-GL05	353	VTX00352	383	GCL-4	413	VTX00288	443	DG13	473	VTX00152	503	MO-G76		
24	pH	54	VTX00191	84	VTX00108	114	VTX00096	144	VTX00037	174	VTX00384	204	INTA-8	234	VTX00318	264	VTX00406	294	VTX00292	324	LH-Cl01	354	VTX00355	384	VTX00150	414	VTX00158	444	VTX00357	474	VTX00136	504	VTX00332		
25	NO3-N	55	VTX00004	85	VTX00312	115	VTX00394	145	VTX00021	175	VTX00132	205	VTX00027	235	VTX00313	265	VTX00261	295	LH-GI01	325	VTX00328	355	VTX00388	385	VTX00293	415	VTX00190	445	VTX00449	475	JD-GL07	505	SS-PG1		
26	N	56	VTX00196	86	VTX00012	116	VTX00184	146	VTX00090	176	VTX00322	206	VTX00435	236	VTX00095	266	VTX00052	296	BD1	326	GCL-9	356	BD3	386	VTX00216	416	VTX00351	446	MO-GC4	476	VTX00307	506	VTX00010		
27	Org C	57	VTX00344	87	VTX00295	117	VTX00159	147	VTX00370	177	DG5	207	VTX00212	237	VTX00008	267	VTX00273	297	VTX00070	327	TJ-DI1	357	LH-Ar01	387	VTX00381	417	VTX00405	447	VTX00378	477	MO-Ar6	507	TJ-GL7		
28	Pb	58	VTX00064	88	VTX00283	118	VTX00151	148	VTX00183	178	VTX00433	208	VTX00146	238	VTX00065	268	VTX00411	298	VTX00418	328	BPA2	358	VTX00396	388	GCL-10	418	JD-PG02	448	VTX00392	478	MO-Ar2	508	VTX00439		
29	As	59	VTX00062	89	VTX00380	119	VTX00099	149	VTX00036	179	VTX00109	209	VTX00255	239	VTX00308	269	INTA-5	299	VTX00264	329	VTX00023	359	SK-C7	389	VTX00324	419	VTX00079	449	VTX00413	479	VTX00038	509	VTX00289		
30	Hg	60	VTX00409	90	VTX00028	120	VTX00013	150	VTX00155	180	DG4	210	VTX00188	240	VTX00310	270	VTX00415	300	VTX00248	330	VTX00006	360	VTX00227	390	VTX00244	420	MO-Ac11	450	VTX00025	480	VTX00279	510	MO-G78		

Fig. 2. All the different variables taken from the EcoBank database.

mary task of the scientist, but it can happen that the public marvels at the complexity of science as they would in front of a work of art. How wonderful are the photos of Earth seen from the Space Station? However, despite the many points that bring the scientist closer to the artist, there are aspects that still mark the distance between the two fields and that can be enriched by an exchange between the two worlds. An example is aesthetics. The scientist is accustomed to scientific visualisation, which demands a primarily functional rigor; the artist's visualisation, on the other hand, becomes aesthetically relevant and adds new points of view for the scientist, creating new stories. It is surprising how the installation created by Marco Barotti, one of the GRIN resident artists, uses almost all the variables recorded in EcoBank[11]. EcoBank is a meta-database for storing, processing and analysing biological samples of different species among the AM (arbuscular mycorrhizal) fungi managed by the University of Tartu, in Estonia. Among the characteristics recorded in the database, the artwork uses: sample, country, site, ecosystem, biome, habitat, plot_latitude, plot_longitude, altitude, pHKCL, P, K, Ca, Mg, Cu, Mn, B, pH, NO3-N, N, Org C, Pb, As, Hg, species count (Figg. 2;3).

Where the Data Analyst would have represented the connection between the data through sophisticated statistical models, the artist expresses it in a completely different way, even though they start from the same set of data. Different points of view help interact with the data in different ways, allowing a better understanding of the phenomenon. The collaborative approach allows complementarity with other mindsets and approaches to analysis, in a continuous two-way exchange.

Fig. 3. FUNGI by Marco Barotti, 2024.

[11] EcoBank website

4. Conclusions

The risk of these initiatives, despite good intentions, is that they may endorse an artistic use of data without fidelity to the sources or, conversely, that science uses art exclusively for communication purposes. The CIMA Foundation, for example, in describing its activities, focuses precisely on the possibility of better communicating science through art, which, although commendable, limits the possibilities that such a connection can instead generate[12].

The true goal should be to counteract disciplinary speciation, aiming for a reciprocal relationship, a two-way relationship that can foster a renewed perspective, the result of the union of both points of view. The contamination between different fields enriches lexically and mentally, broadening and deepening the possibility of ”thinking” new thoughts. The merit of projects like GRIN S+T+ARTS lies also in the recognition given by an authoritative institution, in this case, the European Union, to openness towards different worlds, so that the two cultures, alternatively felt as superior to one another, can come into contact and contaminate each other. Often, the working world views the interactions between scientific-technical knowledge and artistic-humanistic knowledge with suspicion, maintaining a series of silos. GRIN S+T+ARTS, on the other hand, opens the door to possibilities, justifies the exchange, justifying communication as possible and, indeed, desirable. It removes that aura of frivolity in an encounter that, although joyful, is not a futile moment of amusement but an opportunity to enrich all participants. As Sheldrake states, for example, in the study of the relationship between organisms, the term “symbiosis” could only be thought of and thus coined towards the end of the 19th century. However, the difficulty in jumping beyond institutional boundaries kept the study of symbiotic relationships in a neglected condition for much of the 20th century:

> *“Symbiotic interactions reach across species boundaries; studies of symbiotic interactions must reach across disciplinary boundaries” (Sheldrake 2023).*

And this is true not only for the study of symbiotic relationships. Just as Olivetti believed that management should operate in groups of three, bringing together humanistic, scientific, and technical skills to address problems from all perspectives, so S+T+ARTS supports the flourishing of rich hybrid cultures.

[12] CIMA Foundation

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