

## TRANSPARENT HOLOGRAPHIC REGULARITY

### Definition 1. (*strings, chunkings, and identities*)

- A **string**  $s_1 s_2 \dots s_N$  ( $N \geq 1$ ) is a concatenation of a finite number of elements  $s_i$  ( $i = 1, 2, \dots, N$ ) in the order  $s_1, s_2, \dots, s_N$ .
- A **substring** of a string  $S = s_1 s_2 \dots s_N$  is a string  $S_{i,k} = s_i \dots s_{i+k-1}$  of  $k$  successive elements in  $S$  ( $1 \leq i \leq i+k-1 \leq N$ ).
- A **chunking** of a string  $S = s_1 s_2 \dots s_N$  is a partitioning of  $S$  into successive disjoint substrings, yielding a string  $(S_{1,k_1})(S_{k_1+1,k_2}) \dots (S_{N-k_M+1,k_M})$  of  $M$  chunks ( $1 \leq M \leq N$ ).
- An **identity**  $(i \ i+1 \ \dots \ i+k-1) = (j \ j+1 \ \dots \ j+k-1)$  or, for short,  $I(i, j; k)$ , in a string  $S$  is an identity relationship between two identical substrings  $S_{i,k}$  and  $S_{j,k}$  in  $S$ .
- An **elementary identity** in a string  $S$  is an identity  $I(i, j; 1)$  between single elements  $s_i$  and  $s_j$  in  $S$ .

### Definition 2. (*identity chains*)

- An identity set  $G = \{I(i_p, j_p; k_p) \mid p = 1, 2, \dots, n; n \geq 1\}$  in a string  $S$  is an  **$n$ -identity chain** if:
  1.  $i_p + k_p \leq i_q$  for  $p < q$ ,
  2.  $i_p + k_p \leq j_p$  for  $p = 1, 2, \dots, n$ , and
  3. the substrings  $S_{j_p, k_p}$  ( $p = 1, 2, \dots, n$ ) are pairwise disjoint.
- An **elementary  $n$ -identity chain** is an  $n$ -identity chain containing elementary identities only.
- An  **$m$ -identity subchain** of an  $n$ -identity chain  $G = \{g_1, \dots, g_n\}$  is an  $m$ -identity chain  $\{g_p, \dots, g_{p+m-1}\}$  of successive identities in  $G$  ( $1 \leq p \leq p+m-1 \leq n$ ).

### Definition 3. (*alike relations between identity chains*)

- Two  $n$ -identity chains  $\{g_1, g_2, \dots, g_n\}$  and  $\{f_1, f_2, \dots, f_n\}$  are **identical up to an index shift** if an integer constant  $Y$  exists such that, for  $p = 1, 2, \dots, n$ : if  $g_p = I(i, j; k)$  then  $f_p = I(i+Y, j+Y; k)$ .
- For an  $n$ -identity chain  $G = \{I(i_p, j_p; k_p) \mid p = 1, 2, \dots, n\}$  in a string  $S$ , the **complete chunking** of  $S$  on the basis of  $G$  is the chunking of  $S$  into  $C = (c_1)(c_2) \dots (c_M)$ , with  $M$  minimal under the condition that the substrings  $S_{i_p, k_p}$  and  $S_{j_p, k_p}$  ( $p = 1, 2, \dots, n$ ) become precisely one chunk each. The **hierarchical image** of  $G$  then is the elementary  $n$ -identity chain  $\{h_1, h_2, \dots, h_n\}$  in  $C$ , with, for  $p = 1, 2, \dots, n$ : if  $c_{v_p} = S_{i_p, k_p}$  and  $c_{w_p} = S_{j_p, k_p}$  then  $h_p = I(v_p, w_p; 1)$ .

### Definition 4. (*categorization of alike identity chains into identity structures*)

- For an  $n$ -identity chain  $G$ , the  **$n$ -identity structure**  $\Sigma(G)$  is the set of all  $n$ -identity chains the hierarchical image of which is identical to the hierarchical image of  $G$  up to an index shift.
- If  $F$  is an  $m$ -identity subchain of  $G$ , then  $\Sigma(F)$  is an  **$m$ -identity substructure** of  $\Sigma(G)$ .

### Definition 5. (*holographic regularities*)

A **holographic regularity** is a set  $\{\Sigma(H_n) \mid n = 1, 2, \dots, \infty\}$  of  $n$ -identity structures  $\Sigma(H_n)$  with, for every  $n \geq 2$  and every  $m < n$ : all  $m$ -identity substructures of  $\Sigma(H_n)$  are identical to  $\Sigma(H_m)$ .

**Definition 6. (encoding)**

Let  $C = (c_1)(c_2)\dots(c_M)$  be the complete chunking of string  $S$  on the basis of an  $n$ -identity chain  $G$  with hierarchical image  $H = \{I(i_p, j_p; 1) \mid p = 1, 2, \dots, n\}$ . Then, the **encoding** of  $S$  on the basis of  $G$  is the mapping of the pair  $(S, G)$  onto the pair of code components  $[\rho(S, G), \gamma(S, G)]$  with:

1. Code component  $\rho(S, G)$  is the chunk string that results from the order-preserving concatenation of chunk  $(c_{i_1})$  and, for  $2 \leq p \leq n$ , all chunks  $(c_{i_p})$  in  $C$  with  $i_p \neq j_q$  ( $q = 1, 2, \dots, p - 1$ ).
2. Code component  $\gamma(S, G)$  is the possibly empty chunk string that results from the order-preserving concatenation of all chunks  $(c_r)$  in  $C$  with  $r \neq i_p$  and  $r \neq j_p$  ( $p = 1, 2, \dots, n$ ).

**Definition 7. (decoding)**

- For an encoding  $(S, G) \rightarrow [\rho(S, G), \gamma(S, G)]$ , the corresponding **decoding** is the mapping of this encoding onto the string  $S$ .
- A **coding rule** is a decoding function for a set of encodings.

**Definition 8. (holographic coding rules)**

A **holographic coding rule** is a decoding function for a set of **holographic encodings**, that is, encodings that are based on identity chains that belong to holographic regularities.

**Definition 9. (hierarchical transparency)**

- Let  $C$  be the complete chunking of a string  $S$  on the basis of an identity chain  $G$ . A code component in the encoding of  $S$  on the basis of  $G$  is a **transparent code component** if it is empty or just one chunk, or if it is a chunk string  $\Phi = (\phi_1)(\phi_2)\dots(\phi_m)$ , with  $m \geq 2$ , for which there is one and only one chunking  $T = (\tau_1)(\tau_2)\dots(\tau_m)$  of one and only one substring of  $C$  such that  $T$  shares any imaginable identity with  $\Phi$  — if so,  $T$  is the **transparency chunking** for  $\Phi$ .
- An encoding  $(S, G) \rightarrow [\rho(S, G), \gamma(S, G)]$  is a **transparent encoding** if  $\rho(S, G)$  and  $\gamma(S, G)$  are transparent code components.
- A **transparent coding rule** is a decoding function for a set of transparent encodings.

**Definition 10. (SIT's visual coding language: transparent holographic coding rules)**

A **SIT code**  $\bar{X}$  of a string  $X$  is a string  $t_1 t_2 \dots t_m$  such that  $X = D(t_1) \dots D(t_m)$ , where the decoding function  $D : t \rightarrow D(t)$  takes one of the following forms (for strings  $y, p, x_i$ ):

$$\begin{array}{lll}
\mathbf{I-form:} & n * (\bar{y}) & \rightarrow \quad yyy\dots y \quad (n \text{ times } y; n \geq 2) \\
\mathbf{S-form:} & S[\overline{(\bar{x}_1)(\bar{x}_2)\dots(\bar{x}_n)}, (\bar{p})] & \rightarrow \quad x_1 x_2 \dots x_n p x_n \dots x_2 x_1 \quad (n \geq 1) \\
\mathbf{A-form:} & \langle\langle \bar{y} \rangle\rangle / \langle\langle \overline{(\bar{x}_1)(\bar{x}_2)\dots(\bar{x}_n)} \rangle\rangle & \rightarrow \quad yx_1 yx_2 \dots yx_n \quad (n \geq 2) \\
\mathbf{A-form:} & \overline{\langle\langle \bar{x}_1 \rangle\rangle \langle\langle \bar{x}_2 \rangle\rangle \dots \langle\langle \bar{x}_n \rangle\rangle} / \langle\langle \bar{y} \rangle\rangle & \rightarrow \quad x_1 y x_2 y \dots x_n y \quad (n \geq 2) \\
\text{Otherwise:} & D(t) = t & 
\end{array}$$

The chunk  $(\bar{y})$  in I-forms and A-forms is called a **repeat**. The chunk  $(\bar{p})$  in S-forms is called a **pivot** which, as a limit case, may be empty. The chunk strings  $(\bar{x}_1)(\bar{x}_2)\dots(\bar{x}_n)$  in S-forms and A-forms are called an **S-argument** consisting of **S-chunks** and an **A-argument** consisting of **A-chunks**, respectively.

**Definition 11. (SIT's structural information measure)**

Let  $\bar{X}$  be a SIT code of string  $X = s_1 s_2 \dots s_N$ . Then, the **structural information load** (or **I-load**) of  $\bar{X}$ , in **sips**, is given by the sum of, first, the number of remaining string elements  $s_i$  ( $1 \leq i \leq N$ ) and, second, the number of chunks  $(\bar{y})$  in which  $y$  is neither one string element nor one S-chunk.