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Encyclopedia of Distances

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Chapter 28

Distances in Applied Social Sciences

In this chapter we present selected distances used in real-world applications of Human Sciences. In this and the next chapter, the expression of distances ranges from numeric (say, in m) to ordinal (as a degree assigned according to some rule) and nominal.

Depending on the context, the distances are either practical ones, used in daily life and work outside of science, or uncountable ones, used figuratively, say, as metaphors for remoteness (being apart, being unknown, coldness of manner, etc.).

28.1 Distances in Perception and Psychology

- **Distance ceptor**

A **distance ceptor** is a nerve mechanism of one of the organs of special sense whereby the subject is brought into relation with his distant environment.

- **Oliva et al. perception distance**

Let $\{s_1, \dots, s_n\}$ be the set of stimuli, and let q_{ij} be the conditional probability that a subject will perceive a stimulus s_j , when the stimulus s_i was shown; so, $q_{ij} \geq 0$, and $\sum_{j=1}^n q_{ij} = 1$. Let q_i be the probability of presenting the stimulus s_i .

The **Oliva et al. perception distance** ([OSLM04]) between stimuli s_i and s_j is

$$\frac{1}{q_i + q_j} \sum_{k=1}^n \left| \frac{q_{ik}}{q_i} - \frac{q_{jk}}{q_j} \right|.$$

- **Representational dissimilarity matrix**

Representational dissimilarity matrix (or RDM) is a square matrix indexed horizontally and vertically by the stimuli (or experimental conditions) and containing a dissimilarity index in each cell, which compares the two brain-activity patterns associated with stimuli labeling the row and column.

If the same activity pattern estimates are used for the vertical and horizontal dimensions, the RDM is symmetric about a diagonal of zeros. If independent pattern estimates are used for the vertical and horizontal dimensions, the RDM contains entries comparing independent pattern estimates for identical stimuli (reflecting measurement noise) along its diagonal, and two alternative dissimilarity estimates for each stimulus pair in symmetric off-diagonal positions.

- **Visual space**

Visual space refers to a stable perception of the environment provided by vision, while **haptic space** (or *tactile space*) and **auditory space** refer to such internal representation provided by the senses of pressure perception and audition. The geometry of these spaces and the eventual mappings between them are unknown. But Lewin et al., 2012, found that sensitivity to touch is heritable, and linked to hearing. The main observed kinds of distortion of vision and haptic spaces versus physical space follow; the first three were observed for auditory space also.

- *Distance-alleys*: lines with corresponding points perceived as equidistant, are, actually, some hyperbolic curves. Usually, the parallel-alleys are lying within the distance-alleys and, for visual space, their difference is small at > 1.5 m.
- *Oblique effects*: performance of certain tasks is worse when the orientation of stimuli is oblique rather than horizontal or vertical.
- *Equidistant circles*: the **egocentric distance** is direction-dependent; the points perceived as equidistant from the subject lie on egg-like curves, not on circles.

These effects and **size-distance invariance hypothesis** should be incorporated in a good model of visual space. In a visual space the distance d and direction are defined from the self, i.e., as the **egocentric distance**. There is evidence that visual space is almost affine and, if it admits a metric d , then d is a **projective metric**, i.e., $d(x, y) + d(y, z) = d(x, z)$ for any perceptually collinear points x, y, z .

The main models for visual space are a Riemannian space of constant negative curvature (cf. **Riemannian color space** in Chap. 21), a general Riemannian/Finsler space, or an affinely connected (so, not metric, in general) space ([CKK03]).

An *affine connection* is a linear map sending two vector fields into a third one. The expansion of perceived depth on near and its contraction at far distances hints that the mapping between visual and physical space is not affine.

Amedi et al., 2002, observed the convergence of visual and tactile shape processing in the human lateral occipital complex. The *vOICe technology* (OIC for “Oh I see!”) explores cross-modal binding for inducing visual sensations through sound (mental imagery and artificial synesthesia). Some blind people “see” by echolocation. The cane extends peri-hand space of blind users and, in general, extrapersonal or far space can remap as peripersonal or near space when using tools.

Weber’s illusion: two tactile points are perceived as further apart on body parts with higher tactile sensitivity,

- **Length-related illusions**

The most common optical illusions distort size or length. For example, in the *Müller-Lyer illusion*, one of two lines of equal length appear shorter because of the way the arrows on their ends are oriented. Pigeons and parrots also are susceptible to it. Segall et al., 1963, found that the mean fractional misperception varies cross-culturally from 1.4 % to 20.3 % with maximum for Europeans. Also, urban residents and younger subjects are much more susceptible to this illusion.

In the *Luckiech-Sander illusion* (1922), the diagonal bisecting the larger, left-hand parallelogram appears to be longer than the diagonal bisecting the smaller, right-hand parallelogram, but is in fact of the same length.

The perspective created in *Ponzo illusion* (1911) increases the perceived distance and so, compliant with **Emmert's size-distance law**, perceived size increases.

The *Moon illusion* (mentioned in clay tablets at Nineveh in the seventh century BC) is that the Moon, despite the constancy of its visual angle ($\approx 0.52^\circ$), at the horizon may appear to be about twice the zenith Moon. This illusion (and similar *Sun illusion*) could be cognitive: the zenith moon is perceived as approaching. (Plug, 1989, claim that the *distance to the sky*, assumed unconsciously, is about 10–40 m cross-culturally and independent of the consciously perceived distance.) The *Ebbinghouse illusion*: the diameter of the circle, surrounded by smaller circles, appears to be larger than one of the same circle nearby, surrounded by larger circles.

In *vista paradox* (Walker–Rupich–Powell, 1989), a large distant object viewed through a window appears to both shrink in size and recede in distance as the observer approaches; a similar framing effect works in the *coffee cup illusion* (Senders, 1966). In the *Pulfrich depth illusion* (1922), lateral motion of an object is interpreted as having a depth component.

An *isometric illusion* (or *ambiguous figure*) is a shape that can be built of same-length (i.e., isometric) lines, while relative direction between its components are not clearly indicated. The *Necker Cube* is an example.

The *Charpentier size-weight illusion* (1891): the larger of two graspable/liftable objects of equal mass is misperceived to be less heavy than the smaller.

- **Size-distance invariance hypothesis**

The SDIH (**size-distance invariance hypothesis**) by Gilinsky, 1951, is that $\frac{S'}{D'} = C \frac{S}{D}$ holds, where S, D are the physical and S', D' are perceived size and distance of visual stimulus, while C is an observer constant. A simplified formula is $\frac{S'}{D'} = 2 \tan \frac{\alpha}{2}$, where α is the angular size of the stimulus.

A version of SDIH is the **Emmert's size-distance law**: $S' = CD'$. This law accounts for *size constancy*: object's size is perceived to remain constant despite changes in the retinal image (more distant objects appear smaller because of perspective). The Müller-Lyer and Ponzo illusions are examples of size constancy.

The Moon and Ebbinghouse illusions are called **size-distance paradoxes** since they unbalance SDIH. They are misperceptions of visual angle and examples of

distance constancy: distance is perceived constant despite changes in the retinal image.

If an observer's head translates smoothly through a distance K as he views a stationary target point at pivot distance D_p , then the point will appear to move through a displacement W' when it is perceived to be at a distance D' . The **apparent distance/pivot distance hypothesis** (Gogel, 1982): it holds $\frac{D'}{D_p} + \frac{W'}{K} = 1$.

The **size-distance centration** is the overestimation of the size of objects located near the focus of attention and underestimation of it at the periphery.

Hubbard and Baiard, 1988, gave to subjects name and size S of a familiar object and asked imaged distances d_F, d_O, d_V . Here the object mentally looks to be of the indicated size at the *first-sight distance* d_F . The object become, while mentally walking (zooming), too big to be seen fully with zoom-in at the *overflow distance* d_O , and too small to be identified with zoom-out at the *vanishing point distance* d_V . Consistently with SDIH, d_F was linearly related to S . For d_O and d_V , the relation were the power functions with exponents about 0.9 and 0.7. The time needed to imagine d_O increased slower than linearly with the *scan distance* $d_O - d_F$.

Konkle and Oliva, 2011, found that the real-world objects have a consistent visual size at which they are drawn, imagined, and preferentially viewed. This size is proportional to the logarithm of the object's assumed size, and is characterized by the ratio of the object and the frame of space around it. This size is also related to the first-sight distance d_F and to the typical distance of viewing and interaction. A car at a typical viewing distance of 9.15 m subtends a visual angle of 30° , whereas a raisin held at an arm's length subtends 1° . Cf. the **optimal eye-to-eye distance** and, in Chap. 29, the *TV viewing distance* in the **vision distances**.

Similarly, Palmer et al., 1981, found that in goodness judgments of photographs of objects, the $\frac{3}{4}$ *perspective* (or 2.5 view, *pseudo-3D*), in which the front, side, and top surfaces are visually present, were usually ranked highest. Cf. the *axonometric projection* in the **representation of distance in Painting**.

- **Egocentric distance**

The **egocentric distance** is the perceived absolute distance from the self (observer or listener) to an object or a stimulus; cf. **subjective distance**. Usually, such visual distance underestimates the actual physical distance to far objects, and overestimates it for near objects. Such distortion decreases in a lateral direction.

In Visual Perception, the *action space* of a subject is 1–30 m; the smaller and larger spaces are called the *personal space* and *vista space*, respectively.

The **exocentric distance** is the perceived relative distance between objects.

- **Distance cues**

The **distance cues** are cues used to estimate the **egocentric distance**.

For a listener at a fixed location, the main auditory distance cues include: *intensity*, *direct-to-reverberant energy ratio* (in the presence of sound reflecting surfaces), *spectrum* and *binaural differences*; cf. **acoustics distances** in Chap. 21.

For an observer, the main visual distance cues include:

- *relative size, relative brightness, light and shade*;
- *height in the visual field* (in the case of flat surfaces lying below the level of the eye, the more distant parts appear higher);
- *interposition* (when one object partially occludes another from view);
- *binocular disparities, convergence* (depending on the angle of the optical axes of the eyes), *accommodation* (the state of focus of the eyes);
- *aerial perspective* (distant objects become bluer and paler), *distance hazing* (distant objects become decreased in contrast, more fuzzy);
- *motion perspective* (stationary objects appear to a moving observer to glide past).

Examples of the techniques which use the above distance cues to create an optical illusion for the viewer, are:

- *distance fog*: a 3D computer graphics technique such that objects farther from the camera are progressively more blurred (obscured by haze). It is used, for example, to disguise the too-short **draw distance**, i.e., the maximal distance in a 3D scene that is still drawn by the rendering engine;
- *forced perspective*: a technique to make objects appear either far away, or nearer depending on their positions relative to the camera and to each other.
- *lead room*: space left in the direction the subject is facing or moving.

- **Subjective distance**

The **subjective distance** (or *cognitive distance*) is a mental representation of actual distance molded by an individual's social, cultural and general life experiences; cf. **egocentric distance**. Cognitive distance errors occur either because information about two points is not coded/stored in the same branch of memory, or because of errors in retrieval of this information.

For example, the length of a route with many turns and landmarks is usually overestimated. In general, the filled or divided space (distance or area) appears greater than the empty or undivided one. Also, affective signals of threat and disgust increase and decrease, respectively, perceived proximity.

Human mental maps, used to find out distance and direction, rely mainly, instead of geometric realities, on real landscape understanding, via webs of landmarks.

Ellard, 2009, suggests that this loss of natural navigation skills, coupled with the unique ability to imagine themselves in another location, may have given modern humans the freedom to create a reality of their own.

- **Geographic distance biases**

Sources of distance knowledge are either symbolic (maps, road signs, verbal directions) or directly perceived ones during locomotion: environmental features (visually-perceived turns, landmarks, intersections, etc.), travel time/effort.

They relate mainly to the perception and cognition of **environmental distances**, i.e., those that cannot be perceived in entirety from a single point of view but can still be apprehended through direct travel experience.

Examples of **geographic distance biases** (subjective distance judgments) are:

- observers are quicker to respond to locations preceded by locations that were either close in distance or were in the same region;
- distances are overestimated when they are near to a reference point; for example, intercity distances from coastal cities are exaggerated;
- subjective distances are often asymmetrical as the perspective varies with the reference object: a small village is considered to be close to a big city while the big city is likely to be seen as far away from it;
- traveled routes segmented by features are subjectively longer than unsegmented routes; moreover, longer segments are relatively underestimated;
- increasing the number of pathway features encountered and recalled by subjects leads to increased distance estimates;
- structural features (such as turns and opaque barriers) breaking a pathway into separate vistas strongly increase subjective distance (suggesting that distance knowledge may result from a process of summing vista distances) (turns are often memorized as straight lines or right angles);
- *Chicago-Rome illusion*: belief that some European cities are located far to the south of their actual location; in fact, Chicago and Rome are at the same latitude (42°), as are Philadelphia and Madrid (40°), etc.;
- *Miami-Lima illusion*: belief that US east coast cities are located to the east of the west coast cities of South America; in fact, Miami is 3° west of Lima.

Such illusions could be perceptually based mental representations that have been distorted through normalization and/or conceptual nonspatial plausible reasoning.

Thorndyke and Hayes-Roth, 1982, compared distance judgments of people with navigation- and map-derived spatial knowledge. Navigation-derived route distance estimates were more accurate than Euclidean judgments, and this difference diminished with increased exploration. The reverse was true for map subjects, and no improvement was observed in the map learning.

Turner–Turner, 1997, made a similar experiment in a plane virtual building. Route distances were much underestimated but exploration-derived Euclidean judgments were good; repeated exposure did not help. The authors suggest that exploration of virtual environments is similar to navigation in the real world but with a restricted field of view, as in tunnels, caves or wearing a helmet, watching TV.

Krishna et al., 2008, compared spatial judgments of *self-focused* (“Western”) and *relationship-focused* (“Eastern”) people. The former ones were more likely to misjudge distance (when multiple features should be considered), to pay attention to only focal aspects of stimuli and ignore the context and background information.

- **Psychogeography**

Psychogeography is (Debord, 1955) the study of the precise laws and specific effects of the geographical environment, consciously organized or not, on the

emotions and behavior of individuals. An example of related notions is a *desire path* (or *social trail*), i.e., a path developed by erosion caused by animal or human footfall, usually the shortest or easiest route between an origin and destination.

Also, the psychoanalytic study of spatial representation within the unconscious construction of the social and physical world is called *Psychogeography*. In general, *Depth Psychology* refer to unconscious-accounting approaches to therapy and research.

- **Psychological Size and Distance Scale**

The CID (*Comfortable Interpersonal Distance*) scale by Duke and Nowicky, 1972, consists of a center point 0 and eight equal lines emanating from it. Subjects are asked to imagine themselves on the point 0 and to respond to descriptions of imaginary persons by placing a mark at the point on a line at which they would like the imagined person to stop, that is, the point at which they would no longer feel comfortable. CID is then measured in mm from 0.

The GIPSDS (**Psychological Size and Distance Scale**) by Grashma and Ichiyama, 1986, is a 22-item rating scale assessing interpersonal status and affect. Subjects draw circles, representing the drawer and other significant persons, so that the radii of the circles and the distances between them indicate the thoughts and feelings about their relationship. These distances and radii, measured in mm, represent the **psychological distance** and status, respectively. Cf. related questionnaire on http://www.surveymonkey.com/s.aspx?sm=Nd8c_2fazsxMZfK9ryhvzPlw_3d_3d

- **Visual Analogue Scales**

In Psychophysics and Medicine, a **Visual Analogue Scale** (or *VAS*) is a self-report device used to measure the magnitude of internal states such as pain and mood (depression, anxiety, sadness, anger, fatigue, etc.) which range across a continuum and cannot be measured directly. Usually, VAS is a horizontal (or vertical, for Chinese subjects) 10 cm line anchored by word descriptors at each end.

The *VAS score* is the distance, measured in mm, from the left hand (or lower) end of the line to the point marked by the subject. The VAS tries to produce *ratio data*, i.e., ordered data with a constant scale and a natural zero.

Amongst scales used for pain-rating, the VAS is more sensitive than the simpler verbal scale (six descriptive or activity tolerance levels), the Wong–Baker facial scale (six grimaces) and the numerical scale (levels 0, 1, 2, . . . , 10). Also, it is simpler and less intrusive than questionnaires for measuring internal states.

- **Psychological distance**

CLT (*construal level theory*) (Liberman–Trope, 2003, defines **psychological distance** from an event or object as a common meaning of spatial (“where”), temporal (“when”), social (“who”) and hypotheticality (“whether”) distance from it.

Expanding spatial, temporal, social and hypotheticality horizons in human evolution, history and child development is enabled by our capacity for *mental construals*, i.e., abstract mental representations. Any event or object can be represented at *lower-level* (concrete, contextualized, secondary) or *higher-level* (abstract, more schematic, primary) construal.

More abstract construals lead to think of more distant (spatially, temporally, socially, hypothetically) objects and vice versa; cf., say, **temporal distance**.

CLT implied that the four dimensions are functionally similar. For example, increase of distance in only one dimension leads to greater moral concern. Zhang and Wang, 2008, observed that stimulating people to consider spatial distance influences their judgments along three other dimensions, but the reverse is not true.

It is consistent with a claim by Boroditsky, 2000, that the human cognitive system is structured around only concepts emerging directly out of experience, and that other concepts are then built in a metaphorical way. Williams and Bargh, 2008, also claim that psychological distance is a derivative of spatial distance. Spatial concepts such as “near/far” are present at 3 to 4 months of age since the relevant information is readily available to the senses, whereas abstract concepts related to internal states are more difficult to understand. Also, spatial relations between oneself, one’s caretakers and potential predators have primary adaptive significance.

- **Temporal distance**

Temporal distance is a type of **psychological distance** altering individuals’ construals of future or past events (Trope–Liberman, 2003). Immediate events trigger concrete construals, which are characterized by an emphasis on details.

People construe events at greater temporal distance in terms of their abstract, central, goal-related features and pro-arguments, while nearer events are treated situation-specifically at a lower level of counter-arguments. Examples are: greater moral concern over a distant future event, more likely forgiveness by a victim of an earlier transgression, more intense affective consumer’s reaction when a positive outcome is just missed. Also, temporal distance relates to our conceptions of the self. Actor perspective dominates the simulation of a near-future event; it switches to a third-person depiction when the event is located in the distant future.

Spronken et al., 2016, found that in mind-wandering, future-oriented thoughts are more positive compared to past-oriented thoughts. Also, thoughts about the distant past and future are more positive than thoughts about the near past and future, and the frequency of positive thoughts increases with temporal distance.

- **Time-distance relation (in Psychology)**

People often talk about time using spatial linguistic metaphors (a long vacation, a short concert) but much less talk about space in terms of time. This bidirectional but asymmetric relation suggests that spatial representations are primary, and are later co-opted for other uses such as time.

Casanto and Boroditsky, 2008, showed that people, in tasks not involving any linguistic stimuli or responses, are unable to ignore irrelevant spatial information when making judgments about duration, but not the converse. So, the metaphorical space-time relationship observed in language also exists in our more basic representations of distance and duration. Mentally representing time as a linear spatial path may enable us to conceptualize abstract (as moving a meeting forward, pushing a deadline back) and impossible (as time-travel) temporal events.

In Psychology, the *Kappa effect* is that among two journeys of the same duration, one covering more distance appears to take longer, and the *Tau effect* is that among two equidistant journeys, one taking more time to complete appears to have covered more distance. Jones–Huang, 1982, see them as effects of *imputed velocity* (subjects impute uniform motion to discontinuous displays) on judgments of both time and space, rather than direct effect of time (distance) on distance (time) judgment.

Fleet–Hallett–Jepson, 1985, found spatiotemporal inseparability in early visual processing by retinal cells. Maruya–Sato, 2002, reported a new illusion (the time difference of two motion stimuli is converted in the illusory spatial offset) indicating interchangeability of space and time in early visual processing. Simner–Mayo–Spiller, 2009, tested ten individuals with time-space synaesthesia.

The differences appear at the level of higher processing because of different representations: space is represented in retinotopic maps within the visual system, while time is processed in the cerebellum, basal ganglia and cortical structures. Evidence from lesion and human functional brain imaging/interference studies point towards the posterior parietal cortex as the main site where spatial and temporal information converge and interact with each other. Cf. also **spatial-temporal reasoning**.

In human-computer interaction, *Fitts' law* claims that the average time taken to position a mouse cursor over an on-screen target is $a + b \log_2(1 + \frac{D}{W})$, where D is the distance to the center of the target, W is the width (along the axis of motion) of the target and a, b represent the start/stop time and device's speed.

People in the West construct diagonal mental timelines (running from bottom left to the top right); those with damaged right side of their brain have trouble imagining past, i.e., timeline's left side.

Núñez, 2012, found that our spatial representation of time is not innate but learned. The Aymara of the Andes place the past in front and the future behind. The Pormpuraaw of Australia place the past in the east and the future in the west. Some Mandarin speaker have the past above and future below.

For the Yupno of Papua New Guinea, past and future are arranged as a nonlinear 3D bent shape: the past downhill and the future uphill of the local river. Inside of their homes, Yupno point towards the door when talking about the past, and away from the door to indicate future. Yupno also have a native counting system and number concepts but they ignore the number-line concept. They place numbers on the line but only in a categorical manner, ignoring line's extension.

- **Symbolic distance effect**

In Psychology, (symbolic) **distance effect** is the phenomenon that the brain compares two abstract concepts, represented as a continuous space, with higher accuracy and faster reaction time if they differ more on the relevant dimension. For example, the performance of subjects when comparing a pair of positive numbers (x, y) decreases for smaller $|x - y|$ (*behavioral numerical distance effect*).

The related *magnitude effect* is that performance decreases for larger $\min\{x, y\}$. For example, it is more difficult to measure a longer distance (say,

100 m) to the nearest mm than a short distance (say, 1 cm). Those effects correspond to *Weber law*. They are valid also for congenitally blind people; they learn spatial relations via tactile input (interpreting, say, numerical distance by placing pegs in a peg board).

A current explanation is that there exists a mental line of numbers (MNL) which is oriented from left to right (as 2, 3, 4) and nonlinear (more mental space for smaller numbers). So, close numbers are easier to confuse since they are represented on the MNL at adjacent and not always precise locations. Possible MNL's, explaining such confusion, are *linear-scalar* (the psychological distance $d(a, a + 1)$ between adjacent values is constant but the amount of noise increases as ka) or *logarithmic* (amount of noise is constant but $d(a, a + 1)$ decreases logarithmically).

Related *SNARC* (spatial-numerical association of response codes) *effect* is that smaller (or larger) numbers are responded to more easily with responses toward a left (or, respectively, right) location. Also, smaller numbers promote a left-oriented gaze-direction whereas the opposite is true for higher numbers. Similar spatial-musical association *SMARC* and a mental line of pitches were observed. The same (from left to right) mental number line ability was found in three-day-old chicks.

In general, human cognition is often body-based, i.e., conceptual thinking relies on simulations of perceptual symbols. There is now increasing evidence that abstract concepts are also grounded in sensory-motor representations through metaphors. For example, power/status mapped to verticality, physical force to size, social proximity to temperature, and social distance to spatial distance.

- **Law of proximity**

Gestalt Psychology is a theory of mind and brain of the Berlin School, in which the brain is holistic, parallel and self-organizing. Perceptual organization is composed of grouping and segregation. The visual grouping of discrete elements is determined by proximity, similarity, common fate, good continuation, closure (Wertheimer, 1923), and, more recently, common region, connectedness or synchrony.

In particular, the **law of proximity** is that spatial or temporal proximity of elements may induce the mind to perceive a collective or totality.

- **Emotional distance**

The **emotional distance** is the degree of emotional detachment (toward a person, group or events), aloofness, indifference by personal withdrawal, reserve.

The Bogardus Social Distance Scale (cf. **social distance**) measures the distance between two groups by averaged emotional distance of their members.

Spatial empathy is the awareness that an individual has to the proximity, activities, and comfort of people surrounding him.

The *propinquity effect* is the tendency for people to get emotionally involved with those who have higher *propinquity* (physical/psychological proximity) with them, i.e., whom they encounter often. Walmsley, 1978, proposed that emotional involvement decreases as $d^{-\frac{1}{2}}$ with increasing **subjective distance** d .

- **Psychical distance**

Psychical (or *psychic*) **distance** is a term having no commonly accepted definition. In several dictionaries, it is a synonym for the **emotional distance**. This term was introduced in [Bull12] to define what was called later the **aesthetic distance** (cf. the **antinomy of distance**) as a degree of the emotional involvement that a person, interacting with an aesthetic artifact or event, feels towards it.

In Marketing, the psychic distance mean the level of attraction or detachment to a particular country resulting from the degree of uncertainty felt about it.

- **Distancing**

Distancing (from the verb *to distance*, i.e., to move away from or to leave behind) is any behavior or attitude causing to be or appearing to be at a distance.

Uncountable noun **distantness** (or **farness**) is the state or quality of being distant, remote, far-off, way in the distance. Archaic meaning: distant parts or regions.

Distancy, **farawayness**, **distauce** are rare/obsolete synonyms for distance, while **indistancy** is either nearness, or lack (or want) of distance (or separation).

Self-distance is the ability to critically reflect on yourself and your relations from an external perspective; not to confound with mathematical notions of **self-distance** in Chaps. 1 and 17.

Outdistancing means to outrun, especially in a long-distance race, or, in general, to surpass by a wide margin, especially through superior skill or endurance.

In Martial Arts, **distancing** is the selection of an appropriate *combat range*, i.e., distance from the adversary. For other examples of spatial distancing; cf. **distances between people** and, in Chap. 29, **safe distancing** from a risk factor.

Social distancing during pandemic refers to focused measures to increase the physical distance between individuals, or activity restrictions, such as increasing distance between student desks, canceling sports activities, and closing schools.

In *Mediation* (a form of alternative dispute resolution), **distancing** is the impartial and nonemotive attitude of the mediator versus the disputants and outcome.

In Psychoanalysis, **distancing** is the tendency to put persons and events at a distance. It concerns both the patient and the psychoanalyst.

In Developmental Psychology, **distancing** (Werner–Kaplan, 1964, for deaf-blind patients) is the process of establishing the individuality of a subject as an essential phase (prior to symbolic cognition and linguistic communication) in learning to treat symbols and referential language. For Sigel (1970, for preschool children), **distancing** is the process of the development of cognitive representation: cognitive demands by the teacher or the parent help to generate a child's representational competence. **Distancing from role identities** is the first step of 7-th (individualistic) of nine stages of ego development in Loewinger, 1976.

In the books by Kantor, **distancing** refers to APD (Avoidant Personality Disorder): fear of intimacy and commitment in confirmed bachelors, “femmes

fatales”, etc. **Associational distancing** refers to individual’s dissociation with those in the group inconsistent with his desired social identity.

The **distancing language** is phrasing used by a person to avoid thinking about the subject or content of his own statement (for example, referring to death).

Distancing by scare quotes is placing quotation marks around an item (single word or phrase) to indicate that the item does not signify its literal or conventional meaning. The purpose could be to distance the writer from the quoted content, to alert the reader that the item is used in an unusual way, or to represent the writer’s concise paraphrasing. **Neutral distancing** convey a neutral writer’s attitude, while distancing him from an item’s terminology, in order to call attention to a neologism, jargon, a slang usage, etc; sometimes italics are used for it.

Cf. **technology-related distancing, antinomy of distance, distanciation.**

28.2 Distances in Economics and Human Geography

- **Technology distances**

The **technological distance** between two firms is a distance (usually, χ^2 - or **cosine distance**) between their *patent portfolios*, i.e., vectors of the number of patents granted in (usually, 36) technological subcategories. Other measures are based on the number of patent citations, co-authorship networks, etc.

Granstrand’s **cognitive distance** between two firms is the **Steinhaus distance** $\frac{\mu(A \Delta B)}{\mu(A \cup B)} = 1 - \frac{\mu(A \cap B)}{\mu(A \cup B)}$ between their technological profiles (sets of ideas) A and B seen as subsets of a *measure space* $(\Omega, \mathcal{A}, \mu)$.

Olsson, 2000, defined the metric space (I, d) of all ideas (as in human thinking), $I \subset \mathbb{R}_+^n$, with some **intellectual distance** d . The closed, bounded, connected *knowledge set* $A_t \subset I$ extends with time t . New elements are, normally, convex combinations of previous ones: *innovations* within gradual technological progress. Exceptionally, breakthroughs (Kuhn’s paradigm shifts) occur.

The similar notion of *thought space* (of ideas/knowledge and relationships among them in thinking) was used by Sumi et al., 1997, for computer-aided thinking with text; they proposed a system of mapping text-objects into metric spaces.

Introduced by Patel, 1965, the **economic distance** between two countries is the time (in years) for a lagging country to catch up to the same per capita income level as the present one of an advanced country. Nazarczuk, 2015, adapted this notion as the *regional economic distance* and defined the *relative regional distance* as the mean number of years necessary to achieve the reference area GDP per capita, taking into consideration the growth rate of the reference area.

Introduced by Fukuchi–Sato, 1999, the **technology distance** between countries is the time (in years) when a lagging country realizes a similar technological structure as the advanced one has now. The basic assumption of the *Convergence Hypothesis* is that this distance between two countries is smaller than the economic one.

• **Production Economics distances**

In quantitative Economics, a *technology* is modeled as a set of pairs (x, y) , where $x \in \mathbb{R}_+^m$ is an *input* vector, $y \in \mathbb{R}_+^n$ is an *output* vector, and x can produce y . Such a set T should satisfy standard economical regularity conditions.

The **directional distance function** of input/output x, y toward a (projected and evaluated) direction $(-d_x, d_y) \in \mathbb{R}_-^m \times \mathbb{R}_+^n$ is (Chambers–Chung–Färe, 1996)

$$\sup\{k \geq 0 : ((x - kd_x), (y + kd_y)) \in T\}.$$

For $d_x = x, d_y = y$, it is a scaled version of the **Shephard input distance function** (Shephard, 1953 and 1970) $\sup\{k \geq 0 : (x, \frac{y}{k}) \in T\}$.

The *frontier* $f_s(x)$ is the maximum feasible output of a given input x in a given system (or year) s . The **distance to frontier** (Färe–Crosskopf–Lovell, 1994) of a production point (x, y) , where $y = g_s(x)$, is $\frac{g_s(x)}{f_s(x)}$.

The *Malmquist index* measuring the change in TFP (total factor productivity) between periods s, s' (or comparing to another unit in the same period) is $\frac{g_{s'}(x)}{f_s(x)}$. The *distance to frontier* is the inverse of TFP in a given industry (or of GDP per worker in a given country) relative to the existing maximum (the frontier, usually, US). In general, the term *distance-to-target* is used for the deviation in percentage of the actual value from the planned one.

Consider a *production set* $T \subset \mathbb{R}^{n_1} \times \mathbb{R}^{n_2}$ (input, output). The measure of the technical efficiency, given by Briec–Lemaire, 1999, is the point-set distance $\inf_{y \in we(T)} \|x - y\|$ (in a given norm $\|\cdot\|$ on $\mathbb{R}^{n_1+n_2}$) from $x \in T$ to the *weakly efficient set* $we(T)$. It is the set of minimal elements of the poset (T, \leq) where the *partial order* $\leq (t_1 \leq t_2$ if and only if $t_2 - t_1 \in K)$ is induced by the cone $K = \text{int}(\mathbb{R}_{>0}^{n_1} \times \mathbb{R}_{>0}^{n_2}) + \{0\}$.

• **Distance to default**

A *call option* is a financial contract in which the buyer gets, for a fee, the right to buy an agreed quantity of some commodity or financial instrument from the seller at a certain time (the expiration date) for a certain price (the *strike price*).

Let us see a firm’s equity E as a call option on the firm’s assets A , with the total *liabilities* (debt) L being the strike price, i.e., $E = \max(0, A - L)$ with $A < L$ meaning the firm’s default. Applying Black–Sholes, 1973, and Merton, 1974, option pricing formulas, the **distance to default** t periods ahead is defined by

$$D2D_t = \frac{\ln \frac{A_t}{D} + t(\mu_A - \frac{1}{2}\sigma_A^2)}{\sigma_A \sqrt{t}},$$

where μ_A is the rate of growth of A and σ_A is its *volatility* (standard deviation of yearly logarithmic returns). A Morningstar’s credit score is $cs = \frac{7}{2}(D2D + SS) + 8BR + CC \times \max(D2D, SS, BR)$, where SS, BR and CC are the solvency, business risk and cash flow cushion scores. The resulting credit rating AAA, AA, A, BBB etc., corresponds to cs within [16, 23), [23, 61), [61, 96), etc.

- **Action distance**

The **action distance** is the distance between the set of information generated by the Active Business Intelligence system and the set of actions appropriate to a specific business situation. Action distance is the measure of the effort required to understand information and to effect action based on that information. It could be the physical distance between information displayed and action controlled.

- **Effective trade distance**

There is large border effect of political boundaries on the volume of trade and on relative prices. The border introduces costs related to tariffs, market regulations, differences in product packages and languages.

Engel–Rogers, 1996, showed that the dispersion of prices within a country is orders of magnitude smaller than across countries, and estimated that the US–Canadian border was equivalent to a distance of 120,000 km. McCallum, 1995, found that inter-provincial trade within Canada was, on average, 22 times larger than the trade of any province with any State from US. Cf. **impact of distance on trade**.

Borraz et al., 2012, showed that the “online border” in E-commerce is equivalent to the average distance from the online warehouse to the offline stores.

[HeMa02] defined the **effective trade distance** between countries x and y with populations x_1, \dots, x_m and y_1, \dots, y_n of their main agglomerations as

$$\left(\sum_{1 \leq i \leq m} \frac{x_i}{\sum_{1 \leq t \leq m} x_t} \sum_{1 \leq j \leq n} \frac{y_j}{\sum_{1 \leq t \leq n} y_t} d_{ij}^r \right)^{\frac{1}{r}},$$

where d_{ij} is the bilateral distance (in km) of the corresponding agglomerations x_i, y_i , and r measures the sensitivity of trade flows to d_{ij} .

As an **internal distance of a country**, measuring the average distance between producers and consumers, [HeMa02] proposed $0.67 \sqrt{\frac{\text{area}}{\pi}}$.

- **Impact of distance on trade**

Bilateral trade decreases with distance; this effect slightly increased over the last century. Webb, 2007, claims that an average distance of trade in 1962 of 4790 km changed only to 4938 km in 2000.

The relationship between shipments and distance, found in Hillberry–Hummels, 2008, is highly nonlinear: at the beginning, there is a sharp reduction in value with distance; but, once a distance-threshold is achieved the negative effect vanishes.

An example of used measures is the average distance traveled by heavy trucks between actual origins and destinations in their deliveries of commodities.

Frankel–Rose, 2000, estimated impact of certain distance variables on trade, for example, +340 %, +200 %, +80 %, +0.8 %, -0.2 %, -1.1 % for common currency, common language, common border, economic size (1 % GDP increase), physical size (1 % increase), physical distance (1 % increase), respectively.

Using the **gravity models** with 16 *CAGE* (cultural, administrative, geographic, economic) distances between countries, Ghemawat, 2004, developed *CAGE Distance Framework* for managers considering international strategies.

His distances are *cultural* (different languages, ethnicities, religions, social norms), *administrative* (absence of shared monetary or political association, institutional weakness), *geographic* (physical remoteness, different climates, lack of common border or waterway access, weak transportation or communication links) and *economic* (difference in consumer incomes, cost and quality of natural, financial, human resources).

Most affected industries are: meat, cereals, tobacco (by linguistic ties), gold, electricity, textile (by preferential trading agreements), electricity, gas, live animals (by physical remoteness). The wealth difference decreases trade in metals, fertilisers, meat, but increases trade in coffee, tea, animal oils, office machines.

- **Long-distance trade routes**

Examples of such early historic routes are the *Amber Road* (from northern Africa to the Baltic Sea), *Via Maris* (from Egypt to modern day Iran, Iraq, Turkey, Syria), the route *from the Varangians to the Greeks* (from Scandinavia across Kievan Rus' to the Byzantine Empire), the *Incense Road* (from Mediterranean ports across the Levant and Egypt through Arabia to India), Roman-Indian routes, Trans-Saharan trade, *Grand Trunk Road* (from Calcutta to Peshawar) and the *Ancient Tea Route* (from Yunnan to India via Burma, to Tibet and to central China).

The *Silk Road* was, from the second century BC, a network of trade routes connecting East, South, and Western Asia with the Mediterranean world, North/Northeast Africa and Europe. Extending 6500 km, it enabled traders to transport goods, slaves and luxuries such as silk, other fine fabrics, perfumes, spices, medicines, jewels, as well as the spreading of knowledge, ideas, cultures, plants, animals and diseases. But the Silk Road became unsafe and collapsed in the tenth century after the fall of the Tang Dynasty of China, the destruction of the Khazar Khaganate and, later, the Turkic invasions of Persia and the Middle East.

During fifth to tenth centuries, the *Radhanites* (medieval Jewish merchants) dominated trade between the Christian and Islamic worlds, covering much of Europe, North Africa, Middle East, Central Asia and parts of India and China. They carried commodities combining small bulk and high demand (spices, perfumes, jewelry, silk). The *Maritime Republics* (mercantile Italian city-states, especially Genoa, Venice, Pisa, Amalfi) dominated long-distance trade during tenth to thirteenth centuries. The spice trade from Asia to Europe became, via new sea routes, a Portuguese monopoly (fifteenth to seventeenth centuries) replaced by the Dutch, and soon after the English and the French. During thirteenth to seventeenth centuries, the *Hanseatic League* (an alliance of trading cities and their guilds) dominated trade along the coast of Northern Europe.

- **Relational proximity**

Economic Geography considers to nongeographical types of proximity (organizational, institutional, cognitive, etc.). In particular, **relational proximity** (or trust-based interaction between actors) is an inclusive concept of the benefits

derived from spatially localized sets of economic activities. It generates relational capital through the dynamic exchange of locally produced knowledge.

The five dimensions of relational proximity are proximity: of contact (directness), through time (continuity, stability), in diversity (multiplicity, scope), in mutual respect and involvement (parity), of purpose (commonality).

Individuals are close to each other in a relational sense when they share the same interaction structure, make transactions or realize exchanges. They are *cognitively close* if they share the same conventions and have common values and representations (including knowledge and technological capabilities).

Bouba-Olga and Grossetti, 2007, divide socio-economic proximity into relational one (role of social networks) and *mediation proximity* (role of newspapers, directories, Internet, agencies, etc.). Tranos and Nijkamp, 2013: physical distance and relational proximities have a significant impact on Internet's infrastructure.

- **Migration distance (in Economics)**

The **migration distance**, in Economic Geography, is the distance between the geographical centers of the municipalities of origin and destination.

Ravenstein's 2-nd and 3-rd laws of migration (1880) are that the majority of migrants move a short distance, while those move longer distances tend to choose big-city destinations. About 80 % of migrants move within their own country.

Migration tends to be an act of aspiration; it generally improves migrant's wealth and lifestyle. *Existential migrants* refer to voluntary noneconomic expatriates with "existential wanderlust". Madison, 2006, defines them as seeking greater possibilities for self-actualising, exploring foreign cultures in order to assess own identity, and ultimately grappling with issues of home/belonging in the world generally.

- **Commuting distance**

The **commuting distance** is the distance (or travel time) separating work and residence when they are located in separated places (say, municipalities).

The **acceptable commute distance**, in Real Estate, is the distance that can be covered in an acceptable travel time and increases with better connectivity.

- **Consumer access distance**

Consumer access distance is a distance measure between the consumer's residence and the nearest provider where he can get specific goods or services (say, a store, market or a health service). For example, *food miles* refers to the distance food is transported from the time of its production until it reaches consumers.

Measures of geographic access and spatial behavior include distance measures (**map's distance**, **road travel distance**, perceived travel time, etc.), **distance decay** (decreased access with increasing distance) effects, transportation availability and *activity space* (the area of $\approx \frac{2}{3}$ of the consumer's routine activities).

For example, by US Medicare standards, consumers in urban, suburban, rural areas should have a pharmacy within 2, 5, 15 miles, respectively. The patients residing outside of a 15-miles radius of their hospital are called *distant patients*. Food grown within 100 miles of its point of purchase or consumption is *local food*.

Similar studies for retailers revealed that the negative effect of distance on store choice behavior was (for all categories of retailers) much larger when this behavior was measured as “frequency” than when it was measured as “budget share”.

- **Distance decay (in Spatial Interaction)**

In general, **distance decay** or the **distance effect** (Chap. 29) is the attenuation of a pattern or process with distance. In Spatial Interaction, **distance decay** is the mathematical representation of the inverse ratio between the quantity of obtained substance and the distance from its source.

This decay measures the effect of distance on accessibility and number of interactions between locations. For example, it can reflect a reduction in demand due to the increasing travel cost. The quality of streets and shops, height of buildings and price of land decrease as distance from the center of a city increases.

The *bid-rent distance decay* induces, via the cost of overcoming distance, a class-based spatial arrangement around a city: with increasing distance (and so decreasing rent) commercial, industrial, residential and agricultural areas follow.

In location planning for a service facility (fire station, retail store, transportation terminal, etc.), the main concerns are *coverage standard* (the maximum distance, or travel time, a user is willing to overcome to utilize it) and distance decay (demand for service decays with distance).

An example of related *size effect*: doubling the size of a city leads usually to a 15% decrease of resource use (energy, roadway amount, etc.) per capita, a rise of $\approx 15\%$ in socio-economic well-being (income, wealth, the number of colleges, etc.), but also in crime, disease and average walking speed. Bettencourt et al., 2007, observed that “social currencies” (information, innovation, wealth) typically scale superlinearly with city size, while basic needs (water and household energy consumption) scale linearly and transportation/distribution infrastructures scale sublinearly.

Distance decay is related to **friction of distance** which posits that in Geography, the *absolute distance* (say, in km) requires some amount of effort, money, time and/or energy to overcome. The corresponding cost is called *relative distance*; it describes the amount of social, cultural, or economic connectivity between two places.

- **Gravity models**

The general **gravity model** for social interaction is given by the *gravity equation*

$$F_{ij} = a \frac{M_i M_j}{D_{ij}^b},$$

where F_{ij} is the “flow” (or “gravitational attraction”, *interaction, mass-distance function*) from location i to location j (alternatively, between those locations), D_{ij} is the “distance” between i and j , M_i and M_j are the relevant economic “masses” of i and j , and a, b are parameters. Cf. Newton’s **law of universal gravitation**

in Chap. 24, where $b = 2$. The first instances were formulated by Reilly (1929), Stewart (1948), Isard (1956) and Tinbergen (1962).

If F_{ij} is a monetary flow (say, export values), then M is GDP (gross domestic product), and D_{ij} is the distance (usually the **great circle distance** between the centers of countries i and j). For trade, the true distances are different and selected by economic considerations. But the distance is a proxy for transportation cost, the time elapsed during shipment, cultural distance, and the costs of synchronization, communication, transaction. The **distance effect on trade** is measured by the parameter b ; it is 0.94 in Head, 2003, and 0.6 in Leamer–Levinsohn, 1994.

If F_{ij} is a people (travel or migration) or message flow, then M is the population size, and D_{ij} is the travel or communication cost (distance, time, money).

If F_{ij} is the force of attraction from location i to location j (say, for a consumer, or for a criminal), then, usually $b = 2$. Reilly's *law of retail gravitation* is that, given a choice between two cities of sizes M_i, M_j and at distances D_i, D_j , a consumer tends to travel further to reach the larger city with the equilibrium point defined by

$$\frac{M_i}{D_i^2} = \frac{M_j}{D_j^2}.$$

- **Nearness principle**

The **nearness principle** (or Zipf's *least effort principle*, in Psychology) is the following basic geographical heuristic: given a choice, a person will select the route requiring the least expenditure of effort, i.e., path of least resistance.

This principle is used, for example, in transportation planning and locating of serial criminals: they tend to commit their crimes fairly close to where they live.

The **first law of geography** (Tobler, 1970) is: "Everything is related to everything else, but near things are more related than distant things".

- **Distances in Criminology**

Geographic profiling (or *geoforensic analysis*) aims to identify the spatial behavior (target selection and likely *offender's heaven*, i.e., the residence or workplace) of a serial criminal as it relates to the spatial distribution of linked crime sites.

The **offender's buffer zone** is an area surrounding the offender's heaven, from which little or no criminal activity will be observed; usually, such a zone occurs for premeditated personal offenses. The primary streets and network arterials that lead into the buffer zone tend to intersect near the estimated offender's heaven. A 1 km buffer zone was found for the UK serial rapists. Most personal offenses occur within about 2 km from the offender's heaven, while property thefts occur further away.

Given n crime sites (x_i, y_i) , $1 \leq i \leq n$ (where x_i and y_i are the latitude and longitude of the i -th site), the *Newton–Swoope Model* predicts the offender's heaven to be within the circle around the point $(\frac{\sum_i x_i}{n}, \frac{\sum_i y_i}{n})$ with the search

radius being

$$\sqrt{\frac{\max |x_{i_1} - x_{i_2}| \cdot \max |y_{i_1} - y_{i_2}|}{\pi(n-1)^2}},$$

where the maxima are over (i_1, i_2) , $1 \leq i_1 < i_2 \leq n$. The *Ganter–Gregory Circle Model* predicts the offender's heaven to be within a circle around the first offense crime site with diameter the maximum distance between crime sites.

The *centrographic models* estimate the offender's heaven as a *center*, i.e., a point from which a given function of travel distances to all crime sites is minimized; the distances are the Euclidean distance, the Manhattan distance, the **wheel distance** (i.e., the actual travel path), perceived travel time, etc. Many of these models are the reverse of Location Theory models aiming to maximize the placement of distribution facilities in order to minimize travel costs. These models (*Voronoi polygons*, etc.) are based on the **nearness principle** (*least effort principle*).

The **journey-to-crime decay function** is a graphical **distance curve** used to represent how the number of offenses committed by an offender decreases as the distance from his/her residence increases. Such functions are variations of the center of gravity functions; cf. **gravity models**.

For detection of criminal, terrorist and other hidden networks, there are many data-mining techniques which extract latent associations (distances and **near-metrics** between people) from graphs of their co-occurrence in relevant documents, events, etc. In, say, drug cartel networks, better to remove *betweeners* (not well-connected bridges between groups, as paid police) instead of hubs (kingpins).

Electronic tagging consist of a device attached to a criminal or vehicle, allowing their whereabouts to be monitored using GPS. An *ankle monitor* (or *tether*) is a such tracking device that individuals under house arrest or parole are often required to wear. The *range of a tether* (or *inclusion zone*, 10–50m) depends usually on the gravity of the crime; it is set by the offender's probation officer.

- **Drop distance**

In judicial hanging, the **drop distance** is the distance the executed is allowed to fall. In order to reduce the prisoner's physical suffering (to about a third of a second), this distance is pre-determined, depending on his/her weight, by special *drop tables*. For example, the (US state) Delaware protocol prescribes, in pounds/feet, about 252, 183 and 152 cm for at most 55, 77 and at least 100 kg. Unrelated *hanging distance* is the minimum (horizontal) distance needed for hanging a hammock.

In Biosystems Engineering, a ventilation jet *drop distance* is defined as the horizontal distance from an air inlet to the point where the jet reaches the occupational zone. In Aviation, an airlift *drop distance* (or *drop height*) is the

vertical distance between the aircraft and the drop zone over which the airdrop is executed.

- **Distance telecommunication**

Distance telecommunication is the transmission of signals over a distance for the purpose of communication. In modern times, this process almost always involves the use of electromagnetic waves by transmitters and receivers.

Nonelectronic visual signals were sent by fires, beacons, smoke signals, then by mail, pigeon post, hydraulic semaphores, heliographs and, from the fifteenth century, by maritime flags, semaphore lines and signal lamps.

Audio signals were sent by drums, horns (cf. **long-distance drumming** in Chap. 21) and, from nineteenth century, by telegraph, telephone, and radio.

Advanced electrical/electronic signals are sent by television, videophone, fiber optical telecommunications, computer networking, analog cellular mobile phones, SMTP email, Internet and satellite phones.

- **Distance supervision**

Distance supervision refers to the use of interactive distance technology (landline and cell phones, Email, chat, text messages to cell phone and instant messages, video conferencing, Web pages) for live (say, work, training, psychological umbrella, mental health worker, administrative) supervision.

Such supervision requires tolerance for ambiguity when interacting in an environment that is devoid of nonverbal information.

- **Distance education**

Distance education is the process of providing instruction when students and instructors are separated by physical distance, and technology is used to bridge the gap. *Distance learning* and *distance* (or *online*) degrees are the desired outcomes. A *semi-distance program* is one combining online and residential courses.

The **transactional distance** (Moore, 1993) is a perceived degree of separation during interaction between students and teachers, and within each group. This distance decreases with *dialog* (a purposeful positive interaction meant to improve the understanding of the student), with larger autonomy of the learner, and with lesser predetermined structure of the instructional program.

Vygotsky's *zone of proximal development* is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers.

- **Distance selling**

Distance selling, as opposed to face-to-face selling in shops, covers goods or services sold without face-to-face contact between supplier and consumer but through *distance communication means*: press adverts with order forms, catalog sales, telephone, tele-shopping, e-commerce (via Internet), m-commerce (via mobile phone). Examples of the relevant legislation are Consumer Protection (Distance Selling) Directive 97/7/EC and Regulations 2000 in EU.

The main provisions are: clear prior information before the purchase, its confirmation in a durable medium, delivery within 30 days, "cooling-off" period

of seven working days during which the consumer can cancel the contract without any reason and penalty. Exemptions are: *Distance marketing* (financial services sold at distance), business-to-business contracts and some purchases (say, of land, or at an auction, or from vending machines).

- **Approximative human-scale distances**

An **arm's length** is a distance (about 0.7 m, i.e., within **personal distance**) sufficient to exclude intimacy, i.e., discouraging familiarity or conflict; its analogs are: Italian *braccio*, Turkish *pik*, and Old Russian *sazhen*.

The **reach distance** is the difference between the maximum reach and arm's length. The **striking** (or *handshaking*) **distance** is a short, easily reachable distance.

The **whiffing** (or **spitting, poking**) **distance** is a very close distance.

A **stone's throw** is a distance of about 25 fathoms (46 m).

The **hailing** (or **shouting, calling**) **distance** is the distance within which the human voice can be heard. **Far cry**: distance estimated in audibility's terms.

The **Goldilocks distance** is the "just right" one; cf. the **Kasting distance** in Sect. 25.3.

The **walking distance** is the context-dependent distance normally reachable by walking. In Japan, its standard unit is 80 m, i.e., one minute walking time. Some the UK high schools define 2 and 3 miles as the statutory walking distance for children younger and older than 11 years.

Pace out means to measure distance by *spacing* (walking with even steps).

- **Walkability distances**

Walkability is (Abley, 2005) the extent to which the environment is friendly to the presence of people living, shopping, visiting, or spending time in an area.

Walk Score is a walkability index based on the Euclidean distance to amenities such as businesses, schools, parks, and other common destinations within 20 minutes' walk (1 mile = 5280 feet \approx 1.609 km) of a given starting point. The algorithm awards points based on the distance to the closest amenity in each category.

The number of points declines from maximum to 0 as the distance runs from 0.4 km (5 minutes' walk) to 1.6 km. Each category is weighted equally and the points are summed and normalized to yield a score from 0 to 100.

Walk Score also measures pedestrian friendliness by analyzing population density, block length and intersection density. Scores 0 to 49 mean that almost all or most daily errands require a car, and scores 90 to 100 signify a "walker's paradisi".

Walkability is a central principle of *New Urbanism*. In particular, the (urban-to-rural) *transect* is (Duany, 2000) a series of zones that transition from the natural landscape to the dense urban core: T_1 (natural), T_2 (rural), T_3 (suburban), T_4 (general urban), T_5 (urban center), T_6 (downtown).

Block length and building height for $T_3 - T_6$ are, respectively: 700–800, 600, 500, \leq 400 feet and 1–2, 2–3, 2–4, \geq 4 floors. Each zone is *self-similar* in that it contains a similar transition from the edge to the center of the neighborhood.

A **walking radius** is a typical urban walking distance from a given starting point to transit or before driving. It was estimated as 400 m for the US, and larger for Europe. For the US the blog *Walk Appeal* defines the following urban

walking radii: W_6 (2 miles on a highway), W_5 (0.75 mile on a main street, in T_5), W_4 (0.25 mile on a neighborhood street, in T_4), W_3 (0.1 mile on a suburban street, in T_3), W_2 (250 feet on a subdivision street), W_1 (100 feet in parking lot), W_0 (unwalkable).

- **Optimal eye-to-eye distance**

The **optimal eye-to-eye distance** between two persons was measured for some types of interaction. For example, such an optimal viewing distance between a baby and its mother's face, with respect to the immature motor and visual systems of the newborn, is 20–30 cm. During the first weeks of life the accommodation system does not yet function and the lens of the newborn is locked at the **focal distance** of about 19 cm. At ages 8–14 months, babies are judging distances well; they fear a distance with mother (separation anxiety stage) and strangers. Also, left-sided cradling/holding preference have been found in humans and great apes.

- **Language style matching**

During conversation, texting, emailing, and other forms of interactive communication, people unconsciously mimic their partners' language use patterns.

The *LSM* (language style matching) *score* of a dyad (1, 2) of persons, with respect to a *function word type* k , $1 \leq k \leq 9$, is $LSM_i = 2 \frac{\min(l_{1k}, l_{2k})}{l_{1k} + l_{2k}}$, where l_{ik} ($i = 1, 2$) is the percentage of person i 's words of type k . Each dyad's total *LSM* is the mean of its LSM_i across the nine types of *function words*: auxiliary verbs (say, *am*, *will*, *have*), articles, common adverbs (say, *hardly*, *often*), personal pronouns, indefinite pronouns, prepositions, negations, conjunctions (say, *and*, *but*) and quantifiers.

LSM is high within the first 15–30s of any interaction and is generally unconscious. Women use conjunctions at much higher rates.

LSM predicts successful hostage negotiations (Taylor–Thomas, 2008), task group cohesiveness (Gonzales–Hancock–Pennebaker, 2010), and the formation and persistence of romantic relationships (Ireland et al., 2011).

However (Manson et al., 2013), the probability of diad's cooperation in a post-conversation one-shot prisoner's dilemma, is positively related, instead of LSM, to the convergence of their speech rates (mean syllable duration).

- **Distances between people**

In [Hall69], four interpersonal bodily distances were introduced: the *intimate distance* for lovers, childrens, pets (from touching to 46 cm), the *personal-casual distance* for conversations among friends (46–120 cm), the *social-consultative distance* for conversations among acquaintances (1.2–3.7 m), and the *public-audience distance* for public speaking (over 3.7 m). To each of those *proxemics distances*, there corresponds an intimacy/confidence degree and appropriated sound level.

The distance which is appropriate for a given social situation depends on culture, gender and personal preference. For example, under Islamic law, proximity (being in the same room or secluded place) between a man and a woman is permitted only in the presence of their *mahram* (a spouse or anybody from the same sex or a pre-puberty person from the opposite sex). For an average

westerner, personal space is about 70 cm in front, 40 cm behind and 60 cm on either side.

In interaction between strangers, the interpersonal distance between women is smaller than between a woman and a man. The bonding hormone oxytocin discourages partnered (but not a single) men from getting close to a female stranger; they, if were given oxytocin, stayed 10–15 cm farther from the attractive woman.

An example of other cues of nonverbal communication is given by angles of vision which individuals maintain while talking. The **people angular distance in a posture** is the spatial orientation, measured in degrees, of an individual's shoulders relative to those of another; the position of a speaker's upper body in relation to a listener's (for example, facing or angled away). Speaker uses 45° open position in order to make listener feel comfortable and direct body point in order to exert pressure. In general, to approach men directly from the front or women from behind is rude. Also, this distance reveals how one feels about people nearby: the upper body unwittingly angles away from disliked persons and during disagreement.

Eye-contact decreases with spatial proximity. Persons stand closer to those whose eyes are shut. The *Steinzor effect* is the finding that members of leaderless discussion groups seated in circles, are most apt to address remarks to or to get responses from persons seated opposite or nearly opposite them, while in the presence of a strong leader, it happens with persons seated alongside or nearly alongside.

Distancing behavior of people can be measured, for example, by the *stop distance* (when the subject stops an approach since she/he begins to feel uncomfortable), or by the *quotient of approach*, i.e., the percentage of moves made that reduce the interpersonal distance to all moves made.

Humans and monkeys with amygdala lesions have much smaller than average preferred interpersonal distance. *Peripersonal*, i.e., within reach of any limb of an individual, *space* is located dorsally in the parietal lobe whereas *extrapersonal* (outside his reach) *space* is located ventrally in the temporal lobe.

- **Death of Distance**

Death of Distance is the title of the influential book [Cair01] arguing that the telecommunication revolution (the Internet, mobile telephones, digital TV, etc.) initiated the “death of distance” implying fundamental changes: three-shift work, lower taxes, prominence of English, outsourcing, new ways of government control and citizens communication, but also management-at-a-distance and concentration of elites within the “latte belt”. Physical distance (and so, Economic Geography) do not matter; we all live in a “global village”. Friedman, 2005, announced: “The world is flat”. Gates, 2006, claimed: “With the Internet having connected the world together, someone's opportunity is not determined by geography”. The proportion of long-distance relationships in foreign relations increased.

Similarly (see [Ferg03]), steam-powered ships and the telegraph (as railroads previously and cars later) led, via falling transportation/communication costs, to

the “annihilation of distance” in the nineteenth and twentieth centuries. Heine wrote in 1843: “Space is killed by the railways, and we are left with time alone”.

Further in the past, archaeological evidence points out the appearance, ≈ 0.14 Ma ago, long-distance (up to 300 km) trade, and, ≈ 0.04 Ma ago, the innovation of projectile weapons and traps which allowed humans to kill large game (and other humans) from a safe distance.

But already Orwell, 1944, dismissed as “shallowly optimistic” the the phrases “airplane and radio have abolished distance” and “all parts of the world are now interdependent”. Heidegger wrote in 1950: “All distances in time and space are shrinking. . . The peak of this abolition of every possibility of remoteness is reached by television. . .” but “The frank abolition of all distances brings no nearness”. Edgerton, 2006, claims that new technologies foster self-sufficiency and isolation instead.

Modern technology eclipsed distance only in that the time to reach a destination has (usually) shrunk. Distances still matter for, say, a company’s strategy on the emerging markets (cf. **impact of distance on trade**) and for political legitimacy. “Tyranny of distance” still affects small island states in the Pacific.

Partridge et al., 2007, report that proximity to higher-tiered urban centers (with their higher-order services, urban amenities, higher-paying jobs, lower-cost products) increasingly favors local job growth. Increased access to services and knowledge exchange requires more face-to-face interaction and so, an increase in the role of distance. Economic and innovation activity are highly localized spatially and tend to agglomerate more. Also, the social influence of individuals, measured by the frequency of memorable interactions, is heavily determined by distance. Goldenberg–Levy, 2009, show that the IT (Information Technology) revolution which occurred in the 1990s, increased local social interactions (as email, Facebook communication, baby name diffusion) to a greater degree than long-distance ones.

In military affairs, Boulding, 1965, and Bandow, 2004, argued that twentieth century technology reduced the value of proximity for the projection of military power because of “a very substantial diminution in the cost of transportation of armed forces” and “an enormous increase in the range of the deadly projectile”. It was used as partial justification for the withdrawal of US forces from overseas bases in 2004. But Webb, 2007, counter-argues that any easing of transport is countered by increased strain put upon its modes since both sides will take advantage of the falling costs to send more supplies. Also, the greatest movement of logistics continues to be conducted by sea, with little improvement in speed since 1900.

- **Technology-related distancing**

The *Moral Distancing Hypothesis* postulates that technology increases the propensity for unethical conduct by creating a **moral distance** between an act and the moral responsibility for it.

Print technologies divided people into separate communication systems and distanced them from face-to-face response, sound and touch. TV involved

audile-tactile senses and made distance less inhibiting, but it exacerbated *cognitive distancing*: story and image are biased against space/place and time/memory.

This distancing has not diminished with computers but interactivity has increased. In terms of Hunter: technology only re-articulates *communication distance*, because it also must be regarded as the space between understanding and not. The collapsing of spatial barriers diminishes economic but not social and cognitive distance.

The *Psychological Distancing Model* in [Well86] relates the immediacy of communication to the number of information channels: sensory modalities decrease progressively as one moves from face-to-face to telephone, videophone, and e-mail. Skype communication is rated higher than phone since it creates a sense of co-presence. People phone with bad news but text with good news.

Online settings tend to filter out social and relational cues. The lack of instant feedback (since e-mail communication is asynchronous) and low bandwidth limit visual/aural cues. For example, moral and cognitive effects of distancing in online education are not known at present. Also, the shift from face-to-face to online communication can diminish social skills, lead to smaller and more fragmented networks and so, increase feeling of isolation and alienation. But it can be only a bias, based on traditional spatiotemporal assumptions that fairness translates into an increase in mediation and results in blurring of the communication.

Virtual distance is the perceived distance between individuals when their primary way of communication is not face-to-face. The main markers of virtual distance are physical, operational and affinity distances.

Mejias, 2005, define *epistemological distance* and *ontological distance* between things as the difference, respectively, in degree of knowledge justification and in ability of subjects to act upon things. He argue that we should strive towards ontological nearness, using modern information and communication technologies to manipulate temporal/spatial and epistemological distances to attain this goal.

Mejias, 2007, see some new advantages in “uniform distancelessness”, deplored by Heidegger. *Networked proximity* (nearness mediated through new technology) provides shift from physical proximity to informational availability as the main measure of social relevance. It facilitates new kinds of spatially unbound community, and these emerging forms of sociality could be no less meaningful than the older ones. Networked sociality reconfigures distance rather than eliminates it.

28.3 Distances in Sociology and Language

- **Sociometric distance**

The **sociometric distance** refers to some measurable degree of mutual or social perception, acceptance, and understanding. Hypothetically, greater sociometric distance is associated with more inaccuracy in evaluating a relationship.

- **Social distance**

In Sociology, the **social distance** is the extent to which individuals or groups are removed or excluded from participating in one another's lives; a degree of understanding and intimacy which characterize personal and social relations generally. This notion was originated by Simmel in 1903; in his view, the social forms are the stable outcomes of distances interposed between subject and object.

For example (Mulgan, 1991), the centers of global cities are socially closer to each other than to their own peripheries. In general, the notion of social distance is conceptualized in affective, normative or interactive way, i.e., in terms of sympathy the members of a group feel for another group, norms to define in- and outsider, or the frequency/intensity of interactions between two groups.

The *Social Distance Scale* by Bogardus, 1947, offers the following response items: would marry, would have as a guest in my household, would have as next door neighbor, would have in neighborhood, would keep in the same town, would keep out of my town, would exile, would kill; cf. **emotional distance**. The responses for each (say, ethnic/racial) group are averaged across all respondents which yields (say, racial) distance quotient ranging from 1.00 to 8.00.

Dodd and Nehnevasja, 1954, attached distances of 10^t m, $0 \leq t \leq 7$, to eight levels of the Bogardus scale. Many studies on conflicts in ex-Yugoslavia consider *ethnic distance* defined via some modified Bogardus scale, i.e., in terms of acceptance of a particular relation with an abstract person from the other group. Caselli and Coleman, 2012, defined *ethnic distance* as the cost to be born by a member of one group to successfully pass himself as a member of the other group.

An example of relevant models: Akerlof ([Aker97]) defines an *agent* x as a pair (x_1, x_2) of numbers, where x_1 represents the initial, i.e., inherited, social position, and the position expected to be acquired, x_2 . The agent x chooses the value x_2 so as to maximize

$$f(x_1) + \sum_{y \neq x} \frac{e}{(h + |x_1 - y_1|)(g + |x_2 - y_1|)},$$

where e, h, g are parameters, $f(x_1)$ represents the intrinsic value of x , and $|x_1 - y_1|, |x_2 - y_1|$ are the inherited and acquired *social distances* of x from any agent y (with the social position y_1) of the given society.

Hoffman, Cabe and Smith, 1996, define *social distance* as the degree of reciprocity that subjects believe exists within a social interaction.

- **Rummel sociocultural distances**

[Rumm76] defined the main sociocultural distances between two persons as follows.

- **Personal distance:** one at which people begin to encroach on each other's territory of personal space.
- **Psychological distance:** perceived difference in motivation, temperaments, abilities, moods, and states (subsuming **intellectual distance**).

- **Interests-distance**: perceived difference in wants, means, and goals (including **ideological distance** on socio-political programs).
 - **Affine distance**: degree of sympathy, liking or affection between the two.
 - **Social attributes distance**: differences in income, education, race, sex, etc.
 - **Status-distance**: differences in wealth, power, and prestige (including **power distance**).
 - **Class-distance**: degree to which one person is in general authoritatively superordinate to the other.
 - **Cultural distance**: differences in meanings, values and norms reflected in differences in philosophy-religion, science, ethics, law, language, and fine arts.
- **Cultural distance**

The **cultural distance between countries** $x = (x_1, \dots, x_5)$ and $y = (y_1, \dots, y_5)$ (usually, US) is derived (in [KoSi88]) as the following composite index

$$\sum_{i=1}^5 \frac{(x_i - y_i)^2}{5V_i},$$

where V_i is the variance of the index i , and the five indices represent ([Hofs80]):

1. Power distance (preferences for equality);
2. Uncertainty avoidance (risk aversion);
3. Individualism versus collectivism;
4. Masculinity versus femininity (gender specialization);
5. Confucian dynamism (long-term versus short-term orientation).

The above **power distance** measures the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally, i.e., how much a culture has respect for authority. For example, Latin Europe and Japan fall in the middle range.

But for Shenkar–Luo–Yehekel, 2008, above distance is merely a measure of how much a country strayed from the core culture of the multinational enterprise. They propose instead (especially, as a regional construct) the *cultural friction* linking goal incongruity and the nature of cultural interaction.

In order to explain multinational enterprise behavior, Kostova, 1999, introduced the *institutional distance* between its home and host countries as the difference in their regulative, cognitive, and normative institutions. Habib–Zurawicki, 2002, consider effects of the *corruption distance*, i.e., such difference in corruption levels.

Wirsing, 1973, defined *social distance* as a “symbolic gap” between rulers and ruled designed to set apart the political elite from the public. It consists of reinforced and validated ideologies (a formal constitution, a historical myth, etc.).

Davis, 1999, theorized social movements (in Latin America) in terms of their shared distance from the state: geographically, institutionally, socially (class position and income level) and culturally.

The Inglehart–Welzel *cultural map of the world* represent countries as points on \mathbb{R}^2 , in which the two dimensions (*traditional/secular-rational* and *survival/self-expression*) explain > 70 % of cross-national variance in 10 indicators.

- **Trust radius**

People's **trust radius** is the width of the *cooperation circle* (people among whom a certain trust level exists), while *trust level* is the intensity with which people trust other people. The relation between them is weak. Individualism/collectivism is associated with a broader/narrower trust radius. A given level of trust can be broad/narrow if trust is mostly out-group/in-group connoted.

Delhey–Newton–Welzel, 2011, distinguish *in-group trust* (trust in your family, your neighborhood, people you know personally) from *out-group trust* (people you meet for the first time, people of another religion, of another nationality). Respondents were asked whether “most people can be trusted” or “you need to be very careful in dealing with people.” Then this generalized trust was regressed on out-group and in-group trust via the degree of in-group/out-group connotation of the term *most people*. If this term is more in-group connoted, trust radius is narrow, and it is broad otherwise. Quantification of trust radius occurs by estimating linear regression models, separately for all countries in the sample, employing level of trust in *most people* as the dependent variable and scaled measures of in-group and out-group trust levels as the independent variables.

The trust radius is calculated as (rescaled to fit a [0, 1] scale) the difference of the estimated coefficients for out-group and in-group trust. Swiss residents got the widest trust radius (followed by Italy, Slovenia, Sweden, Australia), while Thai residents rank lowest (with Morocco, Burkina Faso, and China).

An unrelated term, the *margin of error*, is usually defined as the *radius* (or half the width) of a *confidence interval* for a particular statistic or observational error. *Confidence level* is usually 90 %, 99 % or, typically, 95 %.

- **Political distance**

A finite metric space $(X = \{x_1, \dots, x_n\}, d)$ can be seen as a *political space* with the points and distance seen as positions (policy proposals) and some **ideological distance**, respectively. Usually, (X, d) is a subspace of $([0, 1]^m, \|x - y\|_2)$.

Let $\{v_1, \dots, v_n\}$ be the vote shares of all candidates $\{c_1, \dots, c_n\}$ of an election or, say, allocated seat shares of all competing parties; so, $\sum_{i=1}^n v_i = 1$. The *index of political diversity* (Ortuño-Ortín and Weber, 2008) is $\sum_{1 \leq i < j \leq n} v_i v_j d(x_i, x_j)$.

The **mean minimum political distance**, cf. <http://wiki.electorama.com/wiki>, is (the case $m = 1$ of) $\sum_{i=1}^n v_i \min_{j \in E} d(x_i, y)$, where $E = \{1 \leq i \leq n : c_i \text{ is elected}\}$. Cf. **distance-rationalizable voting rule** in Chap. 11.

- **Surname distance model**

A **surname distance model** was used in [COR05] in order to estimate the preference transmission from parents to children by comparing, for 47 provinces of mainland Spain, the 47×47 distance matrices for **surname distance** with those of **consumption distance** and **cultural distance**.

The distances were l_1 -distances $\sum_i |x_i - y_i|$ between the frequency vectors (x_i) , (y_i) of provinces x , y , where z_i is, for the province z , either the frequency of the i -th surname (**surname distance**), or the budget share of the i -th product (**consumption distance**), or the population rate for the i -th cultural issue, say, rate of weddings, newspaper readership, etc. (**cultural distance**), respectively.

Other (matrices of) distances considered there are:

- *geographical distance* (in km, between the capitals of two provinces);
- *income distance* $|m(x) - m(y)|$, where $m(z)$ is mean income in the province z ;
- *climatic distance* $\sum_{1 \leq i \leq 12} |x_i - y_i|$, where z_i is the average temperature in the province z during the i -th month;
- *migration distance* $\sum_{1 \leq i \leq 47} |x_i - y_i|$, where z_i is the percentage of people (living in the province z) born in the province i .

Strong *vertical preference transmission*, i.e., correlation between surname and consumption distances, was detected only for food items.

- **Distance as a metaphor**

Lakoff and Núñez, 2000, claim that mathematics emerged via conceptual metaphors grounded in the human body, its motion through space and time, and in human sense perceptions: change is motion, arithmetic is motion along a path, etc.

For them, the mathematical idea of distance comes from the activity of measuring, and the corresponding technique consists of rational numbers and metric spaces. The idea of proximity/connection comes from connecting and corresponds to topological space. The idea of subtraction mathematizes the ordinary idea of distance.

- **Metaphoric distance**

A **metaphoric distance** is any notion in which a degree of similarity between two difficult-to-compare things is expressed using spatial notion of distance as an implicit bidirectional and understandable metaphor. Some examples are:

Internet and Web bring people closer: proximity in subjective space is at-handiness;

professional distance: teacher-student, therapist-patient, manager-employee;

financial distance: degree of separation in couple's money/property arrangements;

competitive distance (incomparability) between two airline product offerings;

metaphoric distance that a creative thinker takes from the problem, i.e., degree of intuitivity, required to evolve/reshape concepts into new ideas.

The **distance-similarity metaphor** (Montello et al., 2003) is a design principle, where relatedness in nonspatial data is projected onto distance, so that semantically similar documents are placed closer to one another in an

information space. It is the inverse of the Tobler's **first law of geography**; cf. **nearness principle**. This metaphor is used in Data Mining, Pattern Recognition and **Spatialization**.

Comparing the linguistic metaphor *proximity*→*similarity* with its mental counterpart, Casasanto (2008), found that stimuli (pairs of words or pictures) presented closer together on the computer screen were rated more similar in conceptual judgments of abstract entities or unseen object properties but, less similar in perceptual judgments of visual appearance of faces and objects.

- **Spatial cognition**

Spatial cognition concerns the knowledge about spatial properties of objects and events: location, size, distance, direction, separation/connection, shape, pattern, and movement. For instance, it consider navigation (locomotion and way-finding) and orientation during it: recognition of landmarks and *path integration* (an internal measuring/computing process of integrating information about movement).

Spatial cognition addresses also our (spatial) understanding of the World Wide Web and computer-simulated virtual reality.

Men surpass women on tests of spatial relations, mental rotation and targeting, while women have better fine motor skills and spatial memory for immobile objects and their location. Such selection should come from a division of labor in Pleistocene groups: hunting of mobile prey for men and gathering of immobile plant foods for women. Women's brains are 10–15 % smaller than men's, but their frontal lobe (decision-making, problem-solving), limbic cortex (emotion regulation) and hippocampus (spatial memory) are proportionally larger, while the parietal cortex (spatial perception) and amygdala (emotional memory) are smaller. Men's brains contain stronger front-to-rear connections (suggesting greater synergy between perception and action) while those of women are better connected from left to right (facilitating emotional processing and the ability to infer others' intentions).

One of the *cultural universals* (traits common to all human cultures) is that men on average travel greater distances over their lifetime. They are less likely than women to migrate within the country of their birth but more likely to emigrate.

- **Size representation**

Konkle and Oliva, 2012, found that object representations is differentiated along the ventral temporal cortex by their real-world size. Both big and small objects activated most of temporal cortex but fMRI (cf. **brain distances**) voxels with a big- or small-object preference were consistently found along its medial or, respectively, lateral parts. These parts overlapped with the regions known to be active when identifying spaces to interact with (say, streets, elevators, cars, chairs) or, respectively, processing information on tools, ones we usually pick up.

Different-sized objects have different action demands and typical interaction distances. Big/small preferences are object-based rather than retinotopic or conceptual. They may derive from systematic biases, say, eccentricity biases and size-dependent biases in the perceptual input and in functional requirements

for action. For example, over the viewing experience, in the lifetime or over evolutionary time, the smaller objects tend to be rounder, while larger objects tend to extend more peripherally on the retina. Cf. the **size-distance invariance hypothesis** and, in Chap. 29, **neurons with spatial firing properties**.

- **Spatialization**

Spatialization (Lefebvre, 1991) refer to the spatial forms that social activities and material things, phenomena or processes take on. It includes cognitive maps, cartography, everyday practice and imagination of possible spatial worlds.

One of the debated definitions of consciousness: it is a notion of self in space and an ability to make decisions based on previous experience and the current situation. Self-awareness permits to evaluate the distance that separates one from his objectives and to adjust his behavior in order to approach those aims.

We usually give the upper face or upper torso as *egocenter* (spatial seat of self).

The term *spatialization* is also used for information display of nonspatial data.

- **Spatial reasoning**

Spatial reasoning is the domain of spatial knowledge representation: spatial relations between spatial entities and reasoning based on these entities and relations.

As a modality of human thought, spatial reasoning is a process of forming ideas through the spatial relationships between objects (as in Geometry), while verbal reasoning is the process of forming ideas by assembling symbols into meaningful sequences (as in Language, Algebra, Programming). *Spatial intelligence* is the ability to comprehend 2D and 3D images and shapes.

Luria, 1973, called the ability to derive the abstract concepts from spatially organized heteromodal information, the *quasi-spatial synthesis*.

Spatial-temporal reasoning (or *spatial ability*) is the capacity to visualize spatial patterns, to manipulate them mentally over a time-ordered sequence of spatial transformations and to draw conclusions about them from limited information.

Specifically, *spatial visualization ability* is the ability to manipulate mentally 2D and 3D figures. *Spatial skills* is the ability to locate objects in a 3D-world using sight or touch. *Spatial acuity* is the ability to discriminate two closely-separated points or shapes (say, two similar polygons with different numbers of sides).

Visual thinking (or *visual/spatial learning*, *picture thinking*) is the common (about 60 % of the general population) phenomenon of thinking through visual processing. Spatial-temporal reasoning is prominent among visual thinkers, as well as among *kinesthetic learners* (who learn through body mapping and physical patterning) and *logical thinkers* (mathematical/systems thinking) who think in patterns and relationships and may work without this being pictorially.

In Computer Science, spatial-temporal reasoning aims at describing, using abstract relation algebras, the common-sense background knowledge on which human perspective of physical reality is based. It provides rather inexpensive reasoning about entities located in space and time.

- **Spatial language**

Spatial language consists of natural-language spatial relations used to indicate where things are, and so to identify or refer to them. It usually expresses imprecise and context-dependent information about space.

Among spatial relations there are *topological* (such as on, to, in, inside, at), *path-related* (such as across, through, along, around), *distance-related* and more complex ones (such as right/left, between, opposite, back of, south of, surround).

A **distance relation** is a spatial relation which specifies how far the object is away from the reference object: near, far, close, etc.

The **distance concept of proximity** (Pribbenow, 1992) is the area around the RO (reference object) in which it can be used for localization of the LO (local object), so that there is visual access from RO and noninterruption of the spatial region between objects, while LO is less directly related to a different object. Such proximity can differ with physical distance as, for example, in “The Morning Star is to the left of the church”. The area around RO, in which a particular relation is accepted as a valid description of the distance between objects, is called the *acceptance area*.

Pribbenow, 1991, proposed five distance distinctions: *inclusion* (acceptance area restricted to projection of RO), *contact/adjacency* (immediate neighborhood of RO), *proximity*, *geodistance* (surroundings of RO) and *remoteness* (the complement of the proximal region around RO).

For Jackendorff–Landau, 1992, there are 3 degrees of distance distinctions in English: interior of RO (*in*, *inside*), exterior but in contact (*on*, *against*), proximate (*near*), plus corresponding negatives, such as *outside*, *off of*, *far from*.

A spatial reference system is mainly egocentric, or relative (such as *right*, *back*) for the languages spoken in industrialized societies, while the languages spoken in small scale societies rely rather on an allocentric, or absolute set of coordinates.

Language affects our sense of space and time. Guugu Yimithirr in Australia do not have words for relative space, like left and right, but they unusually well keep track where they are, using their terms for north, south, east and west.

Semantics of spatial language is considered, say, in Linguistics, Cognitive Psychology, Anatomy, Robotics, Artificial Intelligence, Computer Vision and Geographic Information Systems. An example of far-reaching applications is Grove’s *clean space*, a neuro-linguistic psychotherapy based on the spatial metaphors produced by (or extracted from) the client on his present and desired “space” (state).

- **Language distance from English**

Such measures are based either on a typology (comparing formal similarities between languages), or language trees, or performance (mutual intelligibility and learnability of languages). For example, Rutheford, 1983, defined **distance from English** as the number of differences from English in the following three-way typological classification: subject/verb/object order, topic-prominence/subject-prominence and pragmatic word-order/grammatical word-order. It gives distances 1, 2, 3 for Spanish, Arabic/Mandarin, Japanese/Korean.

Borland, 1983, compared several languages of immigrants by their acquisition of four areas of English syntax: copula, predicate complementation, negation and articles. The resulting ranking was English, Spanish, Russian, Arabic, Vietnamese.

Elder–Davies, 1998, used ranking based on the following three main types of languages: isolating, analytic or root (as Chinese, Vietnamese), inflecting, synthetic or fusional (as Arabic, Latin, Greek), agglutinating (as Turkish, Japanese). It gave ranks 1, 2, 4, 5 for Romance, Slavic, Vietnamese/Khmer, Japanese/Korean, respectively, and 3 for Chinese, Arabic, Indonesian, Malay.

The **language distance index** (Chiswick–Miller, 1998) is the inverse of the *language score* of the average speaking proficiency, after 24 weeks of instruction, of English speakers learning this language. This score was measured at regular intervals by increments of 0.25; it ranges from 1 (hardest to learn) to 3 (easiest to learn). The score was, for example, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25, 2.50, 2.75, 3.00 for Japanese, Cantonese, Mandarin, Hindi, Hebrew, Russian, French, Dutch, Afrikaans.

In addition to the above distances, based on syntax, and **linguistic distance**, based on pronunciation, see the lexical semantic distances in Chap. 22.

Cf. **clarity similarity** in Chap. 14, **distances between rhythms** in Chap. 21, **Lasker distance** in Chap. 23 and **surname distance model** in Chap. 28.

Translations of the English noun *distance*, for example, into French, Italian, German, Swedish, Spanish, Interlingua, Esperanto are: distance, distanza, distanz, distans, distancia, distantia, distanco.

The word *distance* has Nr. 625 in the list (Wiktionary:Frequency lists/PG/2006/04) of the common English words in the books found on Project Gutenberg. It has Nrs. 835, 1035, 2404 in contemporary poetry, fiction, TV/movie and overall Nrs. 1513 (written), 1546 (spoken). It comes from Latin *distantia* (distance, farness, difference) and *distans*, present participle of *distare*: *di* (apart) + *stare* (to stand).

The **longest English word** (noncoined and nontechnical) is *antidisestablishmentarianism* (28 letters). Examples of funny distance-related words in *Urban Dictionary* (Web-based dictionary of slang in English) are: *distading* (start and give up on many goals in quick succession), *distarnated* (having no friends and being hated by everyone), *distanitus* (illness one suffer from spotting a person which looks really good from across the room but is a butterface at 5 feet distance), *disstance* (space provided when someone is *dissing*, i.e., show disrespect for, someone else).

- **Editex distance**

The main phonetic encoding algorithms are (based on English language pronunciation) *Soundex*, *Phonix* and *Phonex*, converting words into one-letter three-digit codes. The letter is the first one in the word and the three digits are derived using an assignment of numbers to other word letters. Soundex and Phonex assign:

0 to *a, e, h, i, o, u, w, y*; 1 to *b, p, f, v*; 2 to *c, g, j, k, q, s, x, z*; 3 to *d, t*;
4 to *l*; 5 to *m, n*; 6 to *r*.

Phonix assigns the same numbers, except for 7 (instead of 1) to f and v , and 8 (instead of 2) to s , x , z .

The **Editex distance** (Zobel–Dart, 1996) between two words x and y is a cost-based **editing metric** (i.e., the minimal cost of transforming x into y by substitution, deletion and insertion of letters). For substitutions, the costs are 0 if two letters are the same, 1 if they are in the same letter group, and 2, otherwise.

The *syllabic alignment distance* (Gong–Chan, 2006) between two words x and y is another cost-based **editing metric**. It is based on Phonix, the identification of syllable starting characters and seven edit operations.

- **Phone distances**

A *phone* is a sound segment having distinct acoustic properties, and is the basic sound unit. A *phoneme* is a minimal distinctive feature/unit in the language (a set of phones which are perceived as equivalent to each other in a given language).

The number of phonemes (consonants) range, among about 7102 languages spoken now, from 11 (6) in Rotokas to 112 (77) in Taa (languages spoken by about 4000 people in Papua New Guinea and Botswana, respectively).

The main classes of the **phone distances** (between two phones x and y) are:

- *Spectrogram-based distances* which are physical-acoustic distortion measures between the sound spectrograms of x and y ;
- *Feature-based phone distances* which are usually the **Manhattan distance** $\sum_i |x_i - y_i|$ between vectors (x_i) and (y_i) representing phones x and y with respect to a given inventory of phonetic features (for example, nasality, stricture, palatalization, rounding, syllabicity).

The **Laver consonant distance** refers to the improbability of confusing 22 consonants among ≈ 50 phonemes of English, developed by Laver, 1994, from subjective auditory impressions. (Chen–Wang–Jia–Dang, 2013, considered similar perception distance between two types of Chinese initials.) The smallest distance, 15 %, is between phonemes $[p]$ and $[k]$, the largest one, 95 %, is, for example, between $[p]$ and $[z]$. Laver also proposed a quasi-distance based on the likelihood that one consonant will be misheard as another by an automatic speech-recognition system.

Each vowel can be represented by a pair (F_1, F_2) of resonant frequencies of the vocal tract (first and second formants). For example, $[u]$, $[a]$, $[i]$ are represented by (350, 800), (850, 1150), (350, 1700) in *mel*s (Chap. 21). The International Phonetic Alphabet identifies seven levels of *height* (F_1) and five levels of *backness* (F_2).

Chang et al., 2013, produced English language map of the brain; they found the set of neurons in the sensorimotor cortex which controls muscles (in the tongue, lips, jaw, larynx) and fires in unique combination for each sound.

- **Phonetic word distance**

The **phonetic word** (or *pronunciation, Levenstein phonological*) **distance** between two words x and y seen as strings of phones is the **Levenstein metric** with costs (Chap. 11): the minimal cost of transforming x into y by

substitution, deletion and insertion of phones. Given a **phone distance** $r(u, v)$ on the International Phonetic Alphabet with the additional phone 0 (silence), the cost of substitution of phone u by v is $r(u, v)$, while $r(u, 0)$ is the cost of insertion or deletion of u .

Levenstein orthographic distance (or *LPD*) is the same measure, but operating on letters instead of phonemes. Words with larger mean LPD to (but smaller mean frequency of) its 20 closest neighbors are easier to recognize.

The average adult has a vocabulary of about 40,000–50,000 words.

- **Linguistic distance**

The **linguistic distance** between two languages is a term loosely used to describe their difference. The mutual intelligibility of the two languages depends on the degree of their lexical, phonetical, morphological, and syntactical similarity.

The **lexical similarity** is the percentage of *common* (similar in form and meaning) words in their standardized wordlists. English was evaluated to have a lexical similarity of 60 %, 27 %, 24 % with German, French and Russian, respectively. Cf. **language distance index**, **language distance effect**, **Swadesh similarity**.

Specifically, the **linguistic (dialectal) distance** between language varieties X and Y is the mean, for a fixed sample S of notions, **phonetic word distance** between *cognate* (i.e., having the same meaning) words s_X and s_Y , representing the same notion $s \in S$ in X and Y , respectively.

One example of a *dialect continuum* (as *ring species* in Biology) is Dutch-German: their mutual intelligibility is small but a chain of dialects connects them.

- **Swadesh similarity**

The *Swadesh word list* of a language (Swadesh, 1940–1950) is a list of vocabulary with (usually, 100) basic words which are acquired by the native speakers in early childhood and supposed to change very slowly over time. The **Swadesh similarity** between two languages is the percentage of *cognate* (having similar meaning and sound) words in their Swadesh lists. *Glottochronology* is a method of assessing the temporal divergence of two languages based on this similarity.

The first 12 items of the original final Swadesh list: *I, you, we, this, that, who?, what?, all, many, one, two*. Cf. the first 12 most frequently used English words: *the, of, and, a, to, in, is, you, that, it, he, was* in all printed material and *I, the, and, to, a, of, that, in, it, my, is, you* across both spoken and written texts.

Acerbi et al., 2013: the frequency of emotional words declined in English-language books over twentieth century, but the use of fear-related words increased from 1980. The *half-life* of a word is the number of years after which it has a 50 % probability of having been replaced by a new noncognate word; roughly, it is within 750–20,000 years, say, 9000, 3200, 1900. *stab, bird, we*.

Pagel et al., 2013, suggest existence of a *proto-Eurasian mother tongue*. For example, they list 15,000 years old words cognate in at least 4 Eurasiatic language families: *thou, I, not, that, we, to give, who, this, what, man/male, ye, old, mother, to hear, hand, fire, to pull, black, to flow, bark, ashes, to spit, worm*.

- **Language distance effect**

In Foreign Language Learning, Corder, 1981, conjectured the existence of the following **language distance effect**: where the mother tongue (L1) is structurally similar to the target language, the learner will pass more rapidly along the developmental continuum (or some parts of it) than where it differs; moreover, all previous learned languages have a facilitating effect.

Ringbom, 1987, added: the influence of the L1 is stronger at early stages of learning, at lower levels of proficiency and in more communicative tasks. But such correlation could be indirect. For example, the written form of modern Chinese does not vary among the regions of China, but the spoken languages differ sharply, while spoken German and Yiddish are close but have different alphabets.

- **Long-distance dependence (in Language)**

In Language, **long-distance dependence** (or *syntactic binding*) is a construction, including wh-questions (such as “Who do you think he likes”), topicalizations (such as “Mary, he likes”), *easy*-adjectives (such as “Mary is easy to talk to”), relative clauses (such as “I saw the woman who I think he likes”)—which permits an element in one position (*filler*) to fulfill the grammatical role associated with another nonadjacent position (*gap*). The *filler-gap distance*, in terms of the number of intervening clauses or words between them in a sentence, can be arbitrary large. Cf. **long range dependence** in Chap. 18.

An *anaphora* is a subsequent reference to an entity already introduced in discourse. In order to be interpreted, anaphora must get its content from an antecedent in the sentence which in English is usually syntactically local as in “Mary excused *herself*”. A **long-distance anaphora** is an anaphora with antecedent outside of its local domain, as in “The players told us stories about *each other*”. Its resolution (finding what it refers to) is a hard problem of machine translation.

The **anaphoric distance** is (Ariel, 1990) the number of words between an anaphora and its antecedent. The **referential distance** (or **textual distance**) is (Givón, 1983) the amount of clauses between them. In general, each text can be represented as a tree in which *discourse units* (normally, clauses) are vertices and *rhetorical relations* (sequence, joint, cause, elaboration, etc.) are edges.

The **rhetorical distance** between two discourse units is (Fox, 1987) the minimal number of “sequence”-edges on a path between them.

28.4 Distances in Philosophy, Religion and Art

- **Zeno’s distance dichotomy paradox**

This paradox by the pre-Socratic Greek philosopher Zeno of Elea claims that it is impossible to cover any distance, because half the distance must be traversed first, then half the remaining distance, then again half of what remains, and so on.

The paradoxical conclusion is that travel over any finite distance can neither be completed nor begun, and so all motion must be an illusion.

But, in fact, dividing a finite distance into an infinite series of small distances and then adding the all together gives back the finite distance one started with.

- **Space (in Philosophy)**

The present Newton–Einstein notion of **space** was preceded by Democritus' (c. 460–370 BC) *Void* (the infinite container of objects), Plato's (c. 424–348 BC) *Khora* (an interval between being and nonbeing in which Forms materialize) and Aristotle's (380–322 BC) *Cosmos* (a finite system of relations between objects). Cf. **Minkowski metric** (Chap. 26) for the origin of the space-time concept.

Like the Hindu doctrines of Vedanta, Spinoza (1632–77) saw our Universe as a mode under two (among an infinity of) attributes, *Thought* and *Extension*, of *God* (unique absolutely infinite, eternal, self-caused substance, without personality and consciousness). These parallel (but without causal interaction) attributes define how substance can be understood: to be composed of thoughts and physically extended in space, i.e., to have breadth and depth. So, the Universe is deterministic.

For Newton (1642–1727) space was absolute: it existed permanently and independently of whether there is any matter in it. It is a framework of creation, stage setting within which physical phenomena occur. For Leibniz's (1646–1716) space was a collection of relations between objects, given by their distance and direction from one to another, i.e., an idealized abstraction from the relations between individual entities or their possible locations which must therefore be discrete.

For Kant (1724–1804) space is not substance or relation, but a part of an unavoidable systematic framework used by the humans to organize their experiences. Disagreement continues between philosophers over whether space is an entity, a relationship between entities, or part of a conceptual framework.

In *biocentric cosmology* (Lanza, 2007), build on quantum physics, space is a form of our animal understanding and does not have an observer-independent reality, while time is the process by which we perceive changes in the Universe. Also, space-time could be not fundamental, but emerging from a deeper quantum reality.

Free space refers to a perfect vacuum, devoid of all particles; it is excluded by the uncertainty principle. The quantum vacuum is devoid of atoms but contains subatomic short-lived particles—photons, gravitons, etc.

A *parameter space* is the set of values of parameters in a mathematical model.

In Mathematics and Physics, the *phase space* (Gibbs, 1901) is a space in which all possible states of the system are represented as unique points; cf. Chap. 18.

- **Kristeva nonmetric space**

Kristeva, 1980, considered the basic psychoanalytic distinction (by Freud) between pre-Oedipal and Oedipal aspects of personality development. Narcissistic identification and maternal dependency, anarchic component drives, polymorphic erotogenicism, and primary processes characterize the pre-Oedipal.

Paternal competition and identification, specific drives, phallic erotogenicism, and secondary processes characterize Oedipal aspects.

Kristeva describes the pre-Oedipal feminine phase by an enveloping, amorphous, “nonmetric” space (Plato’s *khora*) that both nourishes and threatens; it also defines and limits self-identity. She characterizes the Oedipal male phase by a metric space (Aristotle’s *topos*); the self and the self-to-space are more precise and well defined in *topos*. Kristeva insists also on the fact that the semiotic process is rooted in feminine libidinal, pre-Oedipal energy which needs channeling for social cohesion.

Deleuze–Guattari, 1980, divide *multiplicities* (networks, manifolds, spaces) into *striated* (metric, hierarchical, centered, numerical) and *smooth* (“nonmetric, rhizomic, those that occupy space without counting it and can be explored only by legwork”).

The above French post-structuralists use the metaphor of *nonmetric* in line with a systematic (but generating controversy) use of topological terms by the psychoanalyst Lacan. In particular, he sought the space *J* (of *Jouissance*, i.e., sexual relations) as a metric space and used metaphorically the *Heine–Borel theorem* (that closed and bounded subspaces of Euclidean spaces are their only compact subspaces).

Back to Mathematics, when a notion, theorem or algorithm is extended from metric to general distance space, the latter is called **nonmetric space**.

- **Emerson distance between persons**

We call the **Emerson distance between persons** the separation between “gods”, which was required by an American poet and philosopher Ralph Waldo Emerson (1803–82) in his Essay 16 *Manners*: “Let the incommunicable objects of nature and the metaphysical isolation of man teach us independence. . . We should meet each morning, as from foreign countries, and spending the day together, should depart at night, as into foreign countries. In all things I would have the island of a man inviolate. Let us sit apart as the gods, talking from peak to peak all round Olympus. . . Lovers should guard their strangeness. . . Every natural function can be dignified by deliberation and privacy.” At the end of his 1836 book *Nature*, Emerson also wrote: “Every spirit builds itself a house; and beyond its house, a world; and beyond its world, a heaven. . . Build, therefore, your own world.”

Similar dignified separation is mentioned in quotes from the Russian philosopher Mikhail Bakhtin (1895–1975): “The feeling of respect creates a distance, both in relation to the other person, and in relation to one’s own self”, and the Bohemian-Austrian poet Rainer Maria Rilke (1875–1926): “Once the realization is accepted that even between the closest human beings infinite distances continue, a wonderful living side by side can grow, if they succeed in loving the distance between them which makes it possible for each to see the other whole against the sky.”

- **Nietzsche's Ariadne distance**

The German philosopher Friedrich Wilhelm Nietzsche (1844–1900), treated distance in a sensual/erotic way. In “On the Genealogy of Morals” (1887) he wrote:

“The pathos of nobility and distance. . . the fundamental total feeling on the part of a higher ruling nature in relation to a lower nature, to a ‘beneath’ – that is the origin of the opposition between ‘good’ and ‘bad.’”

His Zarathustra favors *fernstenliebe* (love of the farthest) over Christian love of the neighbor. Moreover, *fernstenliebe* is to love neither objects, nor ends—but rather, distance/endlessness itself, which makes all distances recur and perpetuate themselves.

The courtly troubadours of the twelfth century valued eroticization of the unattainable object, while for German romanticism (for example, Novalis, Schopenhauer, Wagner) there can be no satisfaction in erotic relations, or in life itself, as long as distance remains. In Wagner's opera, Tristan laments: “Blessed nearness, tedious distance.”

Kuzma, 2013, claims that Nietzsche, by the early 1880s, “rehabilitated erotic distance”, in response to its denigration and the consummatory idealism and passive nihilism of the German romantic tradition. This rehabilitation of courtly love culminated in the concept of an absolute separation and eternal recurrence.

According to Kuzma, Ariadne in *Thus Spoke Zarathustra* (1883–1885) is not only the symbol of the human soul and life, but Nietzsche's privileged name for absolute, infinite spatially and eternal distance itself, for an eternity conceived in the absence of every end, any possible object to attain and every Other to love. To desire Ariadne, is to desire the incessant prolongation of longing in the absence of all fulfilment. Zarathustra does not seek rest, consummation, and release, but affirms a sort of metaphysical *coitus reservatus*, the eternal prolongation of boundless and unresolved desire, implying “voluptuousness of the future” and “love of fate”.

The eternal recurrence requires spatial or temporal infinity. Nietzsche, in his posthumous notes, posits finite matter and infinite cyclical time.

- **Heidegger's de-severance distance**

The German philosopher Martin Heidegger (1889–1976), sought space in terms of limit and event of placing, not merely a location. He wrote: “space is something that has been spaced, or made room for, and that which is let into its bounds”.

His main notion, *Dasein* (Being there), means Being-in-the-world, as opposed to the Cartesian abstract agent, a subject, or the objective world alone. *Dasein* is revealed by projection into, and engagement with, a personal world, one's environment. It is *ontically* (in factual existence) closest to itself, yet ontologically farthest.

For Heidegger, *Dasein* dwells spatially in the world, but in the *equipmental space* (functional places, defined by *Dasein*-centered totalities of involvements) rather than in physical, Cartesian space, and this spatiality is characterized by *de-severance*, where “*de-severing* amounts to making the farness vanish—that

is, making the remoteness of something disappear, bringing it close". Not only reducing physical distance, de-severance is the *reach* of Dasein's skilled practical activity.

An entity is *nearby* if it is readily available for some such activity, and *far away* if it is not. Nearness comes into being when the thing is examined. We reach it through things; it is nearness that makes the thingness of the thing appear. Cf. *Heidegger's Topology* (MIT Press, 2007) by Malpas. The following quotes (of 1924, 1954, 1966, 1971) illustrate **Heidegger's de-severance distance**:

"Man, as existing transcendence abounding in and surpassing toward possibilities, is a creature of distance. Only through the primordial distances he establishes toward all being in his transcendence does a true nearness to things flourish in him."

"Longing is the agony of the nearness of the distant."

"Then thinking would be coming-into-the-nearness-of distance."

"What is this uniformity in which everything is neither far nor near – is, as it were, without distance? Everything gets lumped together into uniform distancelessness."

Cf. the **technology-related distancing and death of distance** in Sect. 28.2.

French philosopher/writer Maurice Blanchot (1907–2003) considered Nietzsche, Heidegger and Lévinas via their metaphors of distance. For example, he wrote:

"A distance is synonymous with extreme non-coincidence."

"Far and near are dimensions of what escapes presence as well as absence under attraction of [impersonal] 'it'. It draws away, draws close, the same ghostly affirmation, the same premises of non-presence."

"To the proximity of the most distant, to the pressure of what is lightest, . . . to the contact of that which is never arrives, it is by friendship that I can respond, . . . the response of passivity to the non-presence of unknown [stranger]".

- **Lévinas distance to Other**

We call the **Lévinas distance to Other** a primary distance between the individuals in their face-to-face encounter, which the French philosopher and Talmudic scholar Emmanuel Lévinas (1906–95) discusses in his book *Totality and Infinity*, 1961.

Lévinas considers the precognitive relation with the Other: the Other, appearing as the Face, gives itself priority, its first demand even before I react to, love or kill it, is: "thou shalt not kill me". This Face is not an object but pure expression affecting me before I start meditating on it and passively resisting the desire that is my freedom. In this asymmetrical relationship—being silently summoned by the exposed Face of the Other ("widow, orphan, or stranger") and responding by responsibility for the Other without knowing that he will reciprocate—Lévinas (in line of *Misnagdim Judaism* ethics) finds the meaning of being human and concerned about justice. For him, this ethical duty is prior to pursuit of knowledge and ontology of nature.

According to him, before covering the distance separating the *existent* (the lone subject) from the Other, one must first go from anonymous existence to

the existent, from “there is” (swarming of points) to the Being (lucidity of consciousness localized here-below). Lévinas’ ethics spans the distance between the foundational chaos of “there is” and the objective or intersubjective world. Ethics marks the primary situation of the face-to-face, whereas morality comes later as a set of rules emerging in the social situation if there are more than two people face-to-face. And, for Lévinas, the scriptural/traditional God is the Infinite Other.

- **Distant suffering**

Normally, physical distance is inversely related to charitable inclinations. But the traditional morality of “universal” proximity (geographic, age, familial, etc.) and pity not works in contemporary life. Most important actions happen on distance and the *mediation* (capacity of the media to involve us emotionally and culturally) address our concern for the “other”. Cf. **death/kilometer** in Chap. 25.

The nonuniversal quality of humanity should be constructed. So, mass media, NGO’s, aid agencies, live blogs, and celebrity advocacy use imagery in order to encourage audiences to acknowledge, care and act for far away vulnerable others.

For Chouliaraki, 2006, the current mediation replaced earlier claims to our “common humanity” by artful stories that promise to make us better people. As suffering becomes a spectacle of sublime artistic expression, the inactive spectator can merely gaze in disbelief. Arising voyeuristic altruism is motivated by self-empowerment: to realize our own humanity while keeping the humanity of the sufferer outside the remit of our judgement and imagination, i.e., keeping **moral distance**. Chouliaraki calls it *narcissistic self-distance* or *improper distance*.

Silverstone’s (2002) **proper distance in mediation** refers to the degree of proximity required in our mediated interrelationships if we are to create a sense of the other sufficient not just for reciprocity but for a duty of care, obligation and understanding. It should be neither too close to the particularities or the emotionalities of specific instances of suffering, nor too far to get a sense of common humanity as well as intrinsic difference. Cf. **Lévinas distance** and **antinomy of distance**.

Silverstone and Chouliaraki call to represent sufferers as active, autonomous and empowered individuals. They advocate *agonistic solidarity*, treating the vulnerable other as other with her/his own humanity. It requires “an intellectual and aesthetic openness towards divergent cultural experiences, a search for contrasts rather than uniformity” (Hannerz, 1990). For Arendt, 1978, the imagination enables us to create the distance which is necessary for an impartial judgment,

But for Dayan, 2007, a climactic Lévinasian encounter with Other is not dualistic: there are many others awaiting my response at any given moment. So, proper distance should define the point from which one is capable of equitably hearing their respective claims, and it involves the reintroduction of actual distance.

- **Moral distance**

The **moral distance** is a measure of moral indifference or empathy toward a person, group of people, or events. Abelson, 2005, refers to moral distance as the emotional closeness between agent and beneficiary.

But Aguiar, Brañas-Garza and Miller, 2008, define it as the degree of moral obligation that the agent has towards the recipient. So, for them the social distance is only a case of moral distance in which anonymity plays a crucial, negative role.

The **ethical distance** is a distance between an act and its ethical consequences, or between the moral agent and the state of affairs which has occurred.

The (moral) *distancing* is a separation in time or space that reduces the empathy that a person may have for the suffering of others, i.e., that increases moral distance. In particular, **distantiation** is a tendency to distance oneself (physically or socially, by segregation or congregation) from those that one does not esteem. Cf. **distanciation**. On the other hand, the *good distancing* (Sartre, 1943, and Ricoeur, 1995) means the process of deciding how long a given ethical link should be.

- **Simone Weil distance**

We call **Simone Weil distance** a kind of moral God-cross radius of the Universe which the French philosopher, Christian mystic, social activist and self-hatred Jewess, Simone Weil (1909–43) introduced in “The Distance”, one of the philosophico-theological essays comprising her *Waiting for God* (Putnam, New York, 1951).

She connects God’s love to the distance; so, his absence can be interpreted as a presence: “every separation is a link” (Plato’s *metaxu*). She wrote: “God did not create anything except love itself, and the means to love... Because no other could do it, he himself went the greatest possible distance, the infinite distance. This distance between God and God, this supreme tearing apart, this agony beyond all others, this marvel of love, is the crucifixion.”

In her peculiar Christian theodicy, “evil is the form which God’s mercy takes in this world”, and the crucifixion of Christ (the greatest love/distance) was necessary “in order that we should realize the distance between ourselves and God... for we do not realize distance except in the downward direction”. Weil’s *God-cross* (or *creator-creature*) distance recalls the old question: can we equate distance from God with proximity to Evil? Her main drive, purity, consisted of maximizing **moral distance** to Evil, embodied for her by “the social, Rome and Israel”.

Cf. Irenaeus (second century) God-humans **epistemic distance**, which must be far enough that belief in God remains a free choice. In Irenaeian theodicy, God created both, evil/suffering and free will, allowing us moral choices and development.

Cf. Pascal’s (1669) *God-man-nothing* distances in *Pensées*, note 72: “. . . what is man in Nature? A nothing in relation to infinity, all in relation to nothing, a central point between nothing and all and infinitely far from understanding either”.

Cf. Montaigne's (1580) *nothing-smallest* and *smallest-largest* distances in *Essais, III:11 On the lame*: "Yet the distance is greater from nothing to the minutest thing in the world than it is from the minutest thing to the biggest."

Cf. Tipler's (2007) *Big Bang–Omega Point* time/distance with Initial and Final singularities seen as God-Father and God-Son. Tipler's *Omega point* (technological singularity) is a variation of prior use of the term (Teilhard de Chardin, 1950) as the supreme point of complexity and consciousness: the Logos, or Christ.

Calvin's (1537) *Eucharistic theology* (doctrine on the meaning of bread and vine that Christ offered to his disciples during the last supper before his arrest) also relies on spatial distance as a metaphor that best conveys the separation of the world from Christ and of the earthly, human from the heavenly, divine.

Weil's approach reminds that of the Lurian (about 1570) kabbalistic notions: *tzimtzum* (God's concealment, withdrawal of a part, creation by self-delimitation) and *shattering of the vessels* (evil as impure vitality of husks, produced whenever the force of separation loses its distancing function and giving man the opportunity to choose between good and evil). The purpose is to bridge the distance between Infiniteness of God (or Good) and the diversity of existence, without falling into the facility of dualism (as manicheism and gnosticism). It is done by postulating intermediate levels of being (and purity) during emanation (unfolding) within the divine and allowing humans to participate in the redemption of the Creation.

So, a possible individual response to the Creator is purification and *ascent*, i.e., the spiritual movement through the levels of emanation in which the coverings of impurity, that create distance from God, are removed progressively.

Besides, the song "From a Distance", written by Julie Gold in 1985, is about how God is watching us and how, despite the distance (physical and emotional) distorting perceptions, there is still a little peace and love in this world.

- **Golgotha distance**

The exact locations of the Praetorium, where Pilate judged Jesus, and Golgotha, where he was crucified, as well as of the path that Jesus walked, are not known. At present, the Via Dolorosa (600 m from the Antonia Fortress west to the Church of the Holy Sepulchre) in the Old City of Jerusalem, held to be this path.

The first century Jerusalem was about 500 m east to west and 1200 m north to south. Herod's palace (including Praetorium) was about 600 m from Golgotha and 400 m from the Temple. The **Golgotha distance** (total distance from Gethsemane, where Jesus was arrested, to the Crucifixion) was about 1500 m.

Another New Testament's distance is mentioned in Apocalypse: "And the angel thrust in his sickle into the earth, and gathered the vine of the earth, and cast it into the great winepress of the wrath of God. And the winepress was trodden without the city [Jerusalem], and blood came out of the winepress, even unto the horse bridles, by the space of 1600 furlongs [200 miles]" (Revelation 14:19–20). It can hint to the whole length of the land of Israel, computable as 1600 stadia.

- **Distance to Heaven**

Below are given examples of distances and lengths which old traditions related (sometimes as a metaphor) to such notions as God and Heaven.

In the Hebrew text *Shi'ur Qomah* (*The Measure of the Body*), the height of the *Holy Blessed One* is 236×10^7 parasangs, i.e., 14×10^{10} (divine) spans. In the Biblical verse “Who has measured the waters in the hollow of his hand and marked off the heaven with a span” (Isaiah 40:12), the size of the Universe is one such span.

The age/radius of the Universe is 13.82 billion ly. *Sefer HaTemunah* (by Nehunia ben Hakane, first century) and *Otzar HaChaim* (by Yitzchok deMin Acco, thirteenth century) deduced that the world was created *in thought* 42,000 divine years, i.e., $42,000 \times 365,250 \approx 15.3$ billion human years, ago. It counts, using the 42-letter name of the God at the start of Genesis, that now we are in the 6-th of the 7 cosmic *sh'mitah* cycles, each one being 7000 divine years long. *Tohu va-bohu* (formless and empty) followed and 6000 years ago the creation of the world *in deed* is posited.

In the Talmud (Pesahim, 94), the Holy Spirit points out to “impious Nebuchadnezzar” (planning “to ascend above the heights of the clouds like the Most High”): “The distance from earth to heaven is 500 year’s journey alone, the thickness of the heaven again 500 years. . .”. This heaven is the *firmament* plate, and the journey is by walking. Seven other heavens, each 500 years thick, follow and the feet of the holy Creatures are equal to the whole. . . Their ankles, wings, necks, heads and horns are each consecutively equal to the whole.” Finally, “upon them is the Throne of Glory which is equal to the whole”. The resulting journey of 4,096,000 years amounts, at the rate of 80 miles (≈ 129 km) per day, to ≈ 2600 AU, i.e., $\approx \frac{1}{100}$ of the actual distance to Proxima Centauri, the nearest other star. Also, in Talmud, the width of *Jacob’s Ladder* (bridge to Heaven that Jacob dreams about, described in the Book of Genesis) is computed as 8000 parasangs.

On the other hand, *Baraita de Massechet Gehinom* affirms in Section VII.2 that Hell consists of 7 cubic regions of side 300 year’s journey each; so, 6300 years altogether. According to the Christian Bible (Chap. 21 of the Book of Revelation), New Heavenly Jerusalem (a city that is or will be the dwelling place of the Saints) is a cube of side 12,000 furlongs (≈ 2225 km), or a similar pyramid or spheroid.

Islamic tradition (Dawood, Book 40, Nr. 470) also attributes a journey of 71–500 years (by horse, camel or foot) between each *samaa’a* (the ceiling containing one of the seven luminaries: Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn). Besides 7 heavens (as in Judaism and Hinduism), Shia Islam and Sufism have 7 depths of esoteric meanings of Quran, with only God knowing the 4-th meaning.

The Vedic text (Pancavimsab Brahmana, c. 2000 BC) states that the distance to Heaven is 1000 Earth diameters and the Sun (the middle one among seven luminaries) is halfway at 500 diameters. A similar ratio 500–600 was expected

till the first scientific measurement of 1 AU (mean Earth-Sun distance) by Cassini and Richter, 1672. The actual ratio is $\approx 11,728$.

The sacred Hindu number 108 ($=6^2 + 6^2 + 6^2 = \prod_{1 \leq i \leq 3} i^i$), connected to the Golden Ratio as the interior angle 108° of a regular pentagon, is traced to the following Vedic values: 108 Sun's diameters for the Earth-Sun distance and 108 Moon's diameters for the Earth-Moon distance. The actual values are (slightly increasing) ≈ 107.6 and ≈ 110.6 ; they could be computed during an eclipse, since the angular size of the Moon and Sun, viewed from the Earth, is almost identical.

Also, the ratio between the Sun and Earth diameters is ≈ 108.6 , but it is unlikely that Vedic sages knew this. In Ayurveda, the devotee's distance to his "inner sun" (God within) consists of 108 steps; it corresponds to 108 beads of *mala* (rosary): by saying beads, the devotee does a symbolic journey from his body to Heaven.

In Bhagavata, the total diameter of the Universe is about 6.4 billion km.

- **Swedenborg heaven distances**

The Swedish scientist and visionary Emanuel Swedenborg (1688–1772), in Section 22 (Nos. 191–199, *Space in Heaven*) of his main work *Heaven and Hell* (1952, first edition in Latin, London, 1758), posits: "distances and so, space, depend completely on interior state of angels". A move in heaven is just a change of such a state, the length of a way corresponds to the will of a walker, approaching reflects similarity of states. In the spiritual realm and afterlife, for him, "instead of distances and space, there exist only states and their changes".

- **Safir distance**

According to Islamic law, a traveler may shorten the prayers, combine them, and be permitted to break the fast of Ramadan if the travel (*safir*) exceeds some minimum distance. Hanafi, the largest Sunni school of jurisprudence, define such **safir distance** as 3 days of continuous journey (in the great part of the day and at a moderate speed) or 15 *farsakh* (ancient unit of length, called also *parasang*).

Three other main schools define it as 2 days of such journey or as 16 *farsakh*, computed differently. This distance is usually approximated as 80 or 83 km and applied for travel by camel, car, plane or ship. Another strong opinion, by Ibn Taymiyya, claims that *safir* is not merely a distance but also a state of mind, an exposure to the wilderness; so, any distance customarily considered traveling is *safir*.

- **Sabbath distance**

The **Sabbath distance** (or *rabbinical mile*) is a **range distance**: 2000 Talmudic cubits (960–11,152 m, cf. **cubit** in Chap. 27) which an observant Jew should not exceed in a public thoroughfare from any given private place on the Sabbath day. It is about the distance covered by an average man in 18 min.

Other Israelite/Talmudic length units are: a day's march, *parsa*, *stadium* (40, 4, $\frac{2}{15}$ of the rabbinical mile, respectively), and *span*, *hasit*, *palm*, *thumb*, *middle finger*, *little finger* ($\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{6}$, $\frac{1}{24}$, $\frac{1}{30}$, $\frac{1}{36}$ of the Talmudic cubit, respectively).

- **Bible code distance**

Witztum, Rips and Rosenberg, 1994, claimed to have discovered a meaningful subtext of the Book of Genesis, formed by uniformly spaced letters. The text was seen as written on a cylinder on which it spirals down in one long line. Many reactions followed, including criticism by McKay, Bar-Natan, Bar-Hillel and Kalai, 1999, in the same journal *Statistical Science*.

The following **Bible code distance** d_t between two letters, that are t positions apart in the text, was used. Let h be the circumference of the cylinder, and let q and r be the quotient and remainder, respectively, when t is divided by h , i.e., $t = qh + r$ with $0 \leq r \leq h - 1$. Then $d_t = \sqrt{q^2 + r^2}$ if $2q \leq h$, and $d_t = \sqrt{(q + 1)^2 + (r - h)^2}$, otherwise. It is, approximatively, the shortest distance between those letters along the cylinder surface; cf. **cylindrical distance** (Chap. 20).

- **Distance numbers**

On Maya monuments usually only one anchor event is dated absolutely, in the linear *Mesoamerican Long Count calendar* by the number of days passed since the mythical creation on August 11, 3114 BC of the fourth world, which completed a *Great Period* of 13 b'ak'tuns (≈ 5125 years) on December 21, 2012.

The other events were dated by adding to or subtracting from the anchor date some **distance numbers**, i.e., periods from the cyclical 52-year *Calendar Round*.

- **Antinomy of distance**

The **antinomy of distance**, as introduced in [Bull12] for aesthetic experiences by the beholder and artist, is that both should find the right amount of **emotional distance** (neither too involved, nor too detached), in order to create or appreciate art. The fine line between objectivity and subjectivity can be crossed easily, and the amount of distance can fluctuate in time.

The **aesthetic distance** is a degree of emotional involvement of the individual, who undergoes experiences and objective reality of the art, in a work of art. It refers to the gap between the individual's conscious reality and the fictional reality presented in a work of art. It means also the frame of reference that an artist creates, by the use of technical devices in and around the work of art, to differentiate it psychologically from reality; cf. **distanciation**.

Some examples are: the perspective of a member of the audience in relation to the performance, the psychological/emotional distance between the text and the reader, the *actor-character distance* in the Stanislavsky system of acting.

Antinomy between inspiration and technique (embracement and estrangement) in performance theory is called the *Ion hook* since Ion of Ephesus (a reciter of rhapsodic poetry, in a Platon's dialog) employed a double-consciousness, being ecstatic and rational. The acting models of Stanislavsky and Brecht are, respectively, incarnating the role truthfully and standing artfully distanced from it. Cf. **role distance**.

[Morg76] defines pastoral ecstasy as the experience of *role-distancing*, or the authentic self's supra-role suspension, i.e., the capacity of an individual to stand outside or above himself for purposes of critical reflection. Morgan concludes:

“The authentic self is an *ontological possibility*, the social self is an *operational inevitability*, and awareness of both selves and the creative coordination of both is the gift of ecstasy”. Cf. **Lévinas distance to Other**.

The **historical distance**, in terms of [Tail04], is the position the historian adopts *vis-à-vis* his objects—whether far-removed, up-close, or somewhere in between; it is the fantasy through which the living mind of the historian, encountering the inert and unrecoverable, positions itself to make the material look alive. The antinomy of distance appears because historians engage the past not just intellectually but morally/emotionally. The formal properties of historical accounts are influenced by the affective, ideological and cognitive commitments of their authors.

A variation of the antinomy of distance appears in critical thinking: the need to put some emotional and **epistemic** (intellectual) distance between oneself and ideas, in order to better evaluate their validity and avoid *illusion of explanatory depth* (to fail see the trees for the forest). A related problem is how much distance people must put between themselves and their pasts in order to remain psychologically viable; Freud showed that often there is no such distance with childhoods.

- **Role distance**

In Sociology, Goffman, 1961, using a dramaturgical metaphor, defined **role distance** (or *role distancing*) as actions which effectively convey some disdainful detachment of the (real life) performer from a role he is performing. An example of social role distancing is when a teacher explains to students that his disciplinary actions are due only to his role as a teacher.

Goffman observed that children are able to merge doing and being, i.e., *embracement of the performer's role*, only from 3–4 years. Starting from about 5, their role distance (distinguishing being from doing) appears and expands, especially, at age 8, 11 and adult years.

Besides role embracement and role distance, one can play a role cynically in order to manage the outcomes of the situation (impression management). The most likely cause of role distancing is *role conflict*, i.e., the pressure exerted from another role to act inconsistently from the expectations of the first role.

A *frame* is a type of role (participant, observer, authority, critic, artist, etc.) given to a person in relation to a given event. The **frame distance**, introduced by Heathcote, 1980, in teaching drama, refer to a specific (implied by the frame) responsibility, interest, attitude and behavior of a person/student in this event/drama.

- **Distanciation**

In scenic art and literature, **distanciation** (Althusser, 1968, on Brecht's *alienation effect*) consists of methods to disturb purposely (in order to challenge basic codes and conventions of spectator/reader) the *narrative contract* with him, i.e., implicit clauses defining logic behavior in a story. The purpose is to differentiate art psychologically from reality, i.e., to create some **aesthetic distance**.

For Bakhtin, the mandate to “be outside” that which you create is a matter of subject-subject (as opposed to subject-object) relations. For Shklovsky the distancing of an object sharpens our perception and stimulates senses, thereby arousing us to artistic (as opposed to dull everyday) experience.

One of the distanciation devices is *breaking of the fourth wall*, when the actor/author addresses the spectators/readers directly through an imaginary screen separating them. The *fourth wall* is the conventional boundary between the fiction and the audience. It is a part of the *suspension of disbelief* between them: the audience tacitly agrees to provisionally suspend their judgment in exchange for the promise of entertainment. Cf. **distancing** and **distantiatio**.

- **Narrative distance**

The author creates a persona of *narrator*, who tell the story, usually, from the point of view of first- or third-person. **Narrative distance** is (Genette, 1980) the distance between the narrator and the story’s characters, setting, events and objects.

The closest possible distance—the narrator reports on the thoughts and feeling (even unconscious ones) of the characters, while the farthest distance—reporting only actions and situations. The author can vary this distance; say, the third-person omniscient narrator can zoom in and out of character’s perspectives.

- **Ironic distance**

Rhetorical writer or speaker does not allow audience to maintain an objective or fixed distance from the story. He intrude to distance himself from characters in a story or from his own remarks. **Ironic distance** refers to the narrative irony: distance of knowledge between author/narrator/character/reader.

As a literary device, irony implies a distance between what is said and what is meant. Irony is also the art of juxtaposing incongruous parts; so, an *ironic distance* also mean the closeness between two things that never meet.

- **Epistemic distance**

Epistemic (or *intellectual*) **distance** from something refers to the degree of difficulty involved in knowing it. For example, conditional rhetorical constructions are used in discourse, in order to indicate this distance. Mejias (2005) *epistemological distance* between things is the difference in degree of knowledge justification.

- **Representation of distance in Painting**

In Western Visual Arts, the *distance* is the part of a picture representing objects which are the farthest away, such as a landscape; it is the illusion of 3D depth on a flat picture plane. The *middle distance* is the central part of a scene between the foreground and the background (implied horizon).

Perspective projection draws distant objects as smaller to provide additional realism by matching the decrease of their visual angle; cf. Chap. 6. A *vanishing point* (or *point of distance*) is a point at which parallel lines receding from an observer seem to converge. (For a meteor shower, the *radiant* is the point in the sky, from which meteors appear to originate.) *Linear perspective* is a drawing with 1–3 vanishing points; usually, they are placed on the horizon and equipartition it.

In a *curvilinear perspective*, there are ≥ 4 vanishing points; usually, they are mapped into and equipartition a *distance circle*. *0-point perspective* occurs if the vanishing points are placed outside the painting, or if the scene (say, a mountain range) does not contain any parallel lines. Such perspective can still create a sense of *depth* (3D distance) as in a photograph of a mountain range.

In a *parallel projection*, all sets of parallel lines in 3D object are mapped to parallel lines in 2D drawing. This corresponds to a perspective projection with an infinite *focal length* (the distance from the image plane to the projection point).

Axometric projection is parallel projection which is *orthographic* (i.e., the projection rays are perpendicular to the projection plane) and such that the object is rotated along one or more of its axes relative to this plane. The main case of it, used in Engineering Drawing, is **isometric projection** in which the angles between three projection axes are the same, or $\frac{2\pi}{3}$.

In Chinese Painting, the *high-distance*, *deep-distance* or *level-distance* views correspond to picture planes dominated, respectively, by vertical, horizontal elements or their combination. Instead of the perspective projection of a “subject”, assuming a fixed position by a viewer, Chinese classic hand scrolls (up to 10 m in length) used axometric projection. It permitted them to move along a continuous/seamless visual scenario and to view elements from different angles. It was less faithful to appearance and allowed them to present only three (instead of five) of six surfaces of a normal interior. But in Chinese Painting, the focus is rather on symbolic and expressionist representation.

- **Scale in art**

In drawing, the **scale** refers to the proportion or ratio that defines the size relationships. It is used to create the illusion of correct size relationships between objects and figures. The *relative scale* is a method used to create and determine the spatial position of a figure or object in the 3D picture plane: objects that are more distant to the viewer are drawn smaller in size. In this way, the relative size of an object/figure creates the illusion of space on a flat 2D picture.

In an architectural composition, the **scale** is the two-term relationship of the parts to the whole which is harmonized with a third term—the observer. For example, besides the proportions of a door and their relation to those of a wall, an observer measures them against his own dimensions.

The **scale** of an outdoor sculpture, when it is one element in a larger complex such as the facade of a building, must be considered in relation to the scale of its surroundings. In *flower arrangement* (floral decoration), the **scale** indicates relationships: the sizes of plant materials must be suitably related to the size of the container and to each other.

The *hierarchical scale* in art is the manipulation of size and space in a picture to emphasize the importance of a specific object. Manipulating the scales was the theme of *Measure for Measure*, an art/science exhibition at the Los Angeles Art Association in 2010. Examples of the interplay of the small and the large in literature are Swift’s *Gulliver’s Travels* and Carroll’s *Through the Looking Glass*. In the cinema, the spectator can easily be deceived about the size of objects, since scale constantly changes from shot to shot.

In Advertising and Packaging, the size changes the meaning or value of an object. The idea that “bigger is better” is validated by the sales of sport utility vehicles, super-sized soft drinks and bulk food at Wal-Mart.

In reverse, the principle “small is beautiful” is often used to champion small, appropriate objects and technologies that are believed to empower people more. For example, small-sized models sell the benefits of diet programs and fitness regimes designed to scale back people’s proportions. Examples of Japanese miniaturization culture are bonsai and many small/thin portable devices.

- **Distances in Interior Design**

In Interior Design, the *scale* refer to how an item relates to the size of the room or the owner, and the *proportion* refer to the shape of an item and how it relates to other objects in the room. The vertical, horizontal, diagonal and curved lines give a room a feeling of formalness, casualness, transition and sensuality, respectively. Other required space relationships are *balance* (equal weight between objects on either side of a room) and *rhythm* (repetition of patterns, color, or line).

Workplane is the height at which an activity takes place; it is about 90, 75–90 and 75 cm for a kitchen, bath and a dining room or desk. In a kitchen, the perimeter of the *work triangle* formed by sink, cooking surface and refrigerator ideally should be 3.5–7.5 m. In a living room, the triangle of *focal points* to emphasize is formed usually at the door or fireplace, TV, big window, sofa. Other examples of recommended distances are: 35–45 cm between the sofa (or chairs) and coffee table, 60 cm between dining chairs and at least 90 cm for traffic lanes.

Used in lighting calculations, the **room cavity ratio** (or RCR) is $\frac{5hp}{2A}$, where h, P, A are the ceiling height, perimeter and area of the room. So, $RCR = \frac{5h(l+w)}{lw}$ for a rectangular room of length l and width w .

- **Spatialism**

Spatialism (or *Spazialismo*) is an art movement founded by Lucio Fontana in Milan in 1947, intended to synthesize space, color, sound, movement and time into a new “art for the Space Age”. Instead of the illusory virtual space of traditional *easel* (i.e., of a size and on a material suitable for framing) painting, he proposed to unite art and science to project color and form into real space by the use of up-to-date techniques, say, TV and neon lighting. His *Spatial Concept* series consisted of holes or slashes, by a razor blade, on the surface of monochrome paintings.

- **Spatial music**

Spatial music refers to music and sound art (especially, electroacoustic), in which the location and movement of sound sources, in physical or virtual space, is a primary compositional parameter and a central feature for the listener.

Space music is gentle, harmonious sound that facilitates the experience of contemplative spaciousness. Engaging the imagination and generating serenity, it is particularly associated with ambient, New Age, and electronic music.

- **Distance-named cultural products**

Far Near Distance is the name of the program of the House of World Cultures in Berlin which presents contemporary positions of Iranian artists. Examples of similar use of distance terms in modern popular culture follow.

“Some near distance” and “Zero/Distance” are the titles of art exhibitions of Mark Lewis (Bilbao, 2003) and Jim Shrosbree (Des Moines, Iowa, 2007). “A Near Distance” is a paper collage by Perle Fine (New York, 1961); “Quiet Distance” is a fine art print by Ed Mell. “Distance” is a Windows/Mac/Linux survival racing game; “Dream Drop Distance” is a video game for Nintendo.

“Distance” is a Japanese film directed by Hirokazu Koreeda (2001) and an album of Utada Hikaru (her famous ballad is called “Final Distance”). It is also a song by Christina Perry, the stage name of a musician Greg Sanders and the name of the rock/funk band led by Bernard Edwards. “The Distance” is a US film directed by Benjamin Busch (2000), an album by the band “Silver Bullet” and a song by the band “Cake”. “Near Distance” is a musical composition by Chen Yi (New York, 1988) and lyrics by the quartet “Purescence”.

“Distance to Fault”, “Distance from Shelter”, “Long Distance Calling” are the rock bands. Among popular albums are “The Tyranny of Distance”, “The Great Cold Distance”, “Close the Distance”, “The Distance to Here”, “Love and Distance”, “Long Distance Voyager” and “The Crawling Distance”, “This Magnificent Distance” by the bands “Washington, D.C.”, “Katatonia”, “Go Radio”, “Live”, “The Helio Sequence”, “The Moody Blues” and Robert Pollard, Chris Robinson.

The terms *near distance* and *far distance* are also used in Ophthalmology and for settings in some sensor devices.

- **Distance-related quotes**

- “Respect the gods and the devils but keep them at a distance.” (Confucius)
- “Sight not what’s near through aiming at what’s far.” (Euripides)
- “It is when suffering seems near to them that men have pity.” (Aristotle)
- “Distance in space or time weakened all feelings and all sorts of guilty conscience.” “Distance is a great promoter of admiration.” (Denis Diderot)
- “Our main business is not to see what lies dimly at a distance, but to do what lies clearly at hand.” (Thomas Carlyle)
- “We can only see a short distance ahead, but we can see plenty there that needs to be done.” (Alan Turing)
- “The foolish man seeks happiness in the distance; the wise grows it under his feet.” (Julius Robert Oppenheimer)
- “The very least you can do in your life is to figure out what you hope for. And the most you can do is live inside that hope. Not admire it from a distance but live right in it, under its roof.” (Barbara Kingsolver)
- “Better is a nearby neighbor, than a far off brother.” (Proverbs 27:10, Bible)
- “These [patriarchs] all died in faith without receiving the things promised [Canaan, Messiah, Gospel], but they saw them and welcomed them from

a distance, admitting that they were strangers and pilgrims on the earth.” (Hebrews 11:13, Bible)

- “By what road”, I asked a little boy, sitting at a cross-road, “do we go to the town?”—“This one”, he replied, “is short but long and that one is long but short”. I proceeded along the “short but long road”. When I approached the town, I discovered that it was hedged in by gardens and orchards. Turning back I said to him, “My son, did you not tell me that this road was short?”—“And”, he replied, “Did I not also tell you: “But long?”” (Erubin 53b, Talmud)
- “The Prophet Muhammad was heard saying: “The smallest reward for the people of paradise is an abode where there are 80,000 servants and 72 wives, over which stands a dome decorated with pearls, aquamarine, and ruby, as wide as the distance from Al-Jabiyyah [a Damascus suburb] to Sana’a [Yemen].” (Hadith 2687, Islamic Tradition)
- “The closer the look one takes at the world, the greater distance from which it looks back.” (Karl Kraus)
- “Telescopes and microscopes are designed to get us closer to the object of our studies. That’s all well and good. But it’s as well to remember that insight can also come from taking a step back.” (New Scientist, March 31, 2012)
- “Where the telescope ends, the microscope begins. Which of the two has the grander view?” (Victor Hugo)
- “Nature uses only the longest threads to weave her patterns.” (Richard Feynman)
- “We’re about eight Einsteins away from getting any kind of handle on the universe.” (Martin Amis)
- “It is true that when we travel we are in search of distance. But distance is not to be found. It melts away. And escape has never led anywhere . . . What are we worth when motionless, is the question.” (Antoine de Saint-Exupéry)
- “If you want to build a ship, don’t drum up people to collect wood and don’t assign them tasks and work, but rather teach them to long for the endless immensity of the sea.” (Antoine de Saint-Exupéry)
- “Ships at a distance have every man’s wish on board.” (Zora Neale Hurston)
- “If you’ve never stared off in the distance, then your life is a shame.” (Adam Duritz)
- “Every once in a while, people need to be in the presence of things that are really far away.” (Ian Frazier)
- “Only those who will risk going too far can possibly find out how far one can go.” (Thomas Stearns Eliot)
- “Distance is to love like wind is to fire . . . it extinguishes the small and kindles the great.” (source unknown)
- “I could never take a chance of losing love to find romance
In the mysterious distance between a man and a woman.” (Performed by U2)
- “In true love the smallest distance is too great, and the greatest distance can be bridged.” (Hans Nouwens)

- “Love is like a landscape which doth stand
Smooth at a distance, rough at hand.” (Robert Hegge)
- “Life is like a landscape. You live in the midst of it but can describe it only from the vantage point of distance.” (Charles Lindbergh)
- “Distance between two people is only as one allows it to be.” (source unknown)
- “It is only the mountains which never meet.” (french proverb)
- “Nothing makes Earth seem so spacious as to have friends at a distance; they make the latitudes and longitudes.” (Henri David Thoreau)
- “Distance can endear friendship, and absence sweeteneth it.” (James Howell)
- “The word is distance within non-distance, that is, the width of a gap that every letter stresses while bridging it. What is said is always said in relation to what will never be expressed. At these limits we recognize ourselves.” (Edmond Jabès)
- “The poet’s other readers are the ancient poets, who look upon the freshly written pages from an incorruptible distance. Their poetic forms are permanent, and it is difficult to create new forms which can approach them.” (Salvatore Quasimodo)
- “Sad things are beautiful only from a distance . . . From a distance of 130 years i’m going to distance myself until the world is beautiful. . .” (Tao Lin)
- “Dying away into the distance, prose turns into poetry, speech into vocalise, language into music.” (Berthold Hoeckner)
- “Everything becomes romantic and poetic, if one removes it to a distance . . . Distant philosophy sounds like poetry – for each call into the distance becomes a vowel . . . Everything becomes poetry – poem from afar.” (Novalis)
- “The appropriated way to determine whether a painting is melodious is to look at it from a distance so as to be unable to comprehend its subject or its lines.” (Charles Baudelaire)
- “There is no object so large . . . that at great distance from the eye it does not appear smaller than a smaller object near.” (Leonardo da Vinci)
- “Distance lends enchantment to the view,
And robes the mountain in its azure hue.” (Thomas Campbell)
- “There are charms made only for distant admiration.”
“Distance has the same effect on the mind as on the eye.” (Samuel Johnson)
- “Age, like distance, lends a double charm.” (Oliver Wendell Holmes)
- “Distance not only gives nostalgia, but perspective, and maybe objectivity.” (Robert Morgan)
- “It is the just distance between partners who confront one another, too closely in cases of conflict and too distantly in those of ignorance, hate and scorn, that sums up rather well, I believe, the two aspects of the act of judging. On the one hand, to decide, to put an end to uncertainty, to separate the parties; on the other, to make each party recognize the share the other has in the same society.” (Paul Ricoeur)
- “Authority doesn’t work without prestige, or prestige without distance.” (Charles de Gaulle)

- “The human voice can never reach the distance that is covered by the still small voice of conscience.” (Mohandas Gandhi)
- “A smile is the shortest distance between two people.” (Victor Borge)
- “The shortest distance between two points is under construction.” (Leo Aikman)
- “A straight line may be the shortest distance between two points, but it is by no means the most interesting.” (Third Doctor from BBC TV series *Doctor Who*)
- “In politics a straight line is the shortest distance to disaster.” (John P. Roche)
- “Fret not where the road will take you. Instead concentrate on the first step. That is the hardest part and that is what you are responsible for. Once you take that step let everything do what it naturally does and the rest will follow. Do not go with the flow. Be the flow.” (Shams Tabrisi)
- “The distance is nothing; only the first step that is difficult.” (Marie du Deffand)
- “A perfect run has nothing to do with distance. It’s when your stride feels comfortable.” (Sean Astin)
- “Fill the unforgiving minute with sixty seconds worth of distance run.” (Rudyard Kipling)
- “The distance between dreams and reality is called Discipline.” (Albert Wright)
- “The distance between who you are and who you might be is closing.” (Jan Chipchase)
- “Everywhere is within walking distance if you have the time.” (Steven Wright)
- “Time is the longest distance between two places.” (Tennessee Williams)
- “There is an immeasurable distance between late and too late.” (Og Mandino)
- “They couldn’t hit an elephant at this distance.” (last words of John Sedgwick, seconds before he was mortally wounded)
- “The distance that the dead have gone does not at first appear; Their coming back seems possible for many an ardent year.” (Emily Dickinson)
- “A vast similitude interlocks all . . . All distances of place however wide, All distances of time, all inanimate forms, all souls . . .” (Walt Whitman)