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Magic Social Numbers

On the Social Geometry of Human Groups

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Abstract. – The article discusses human groupings from the perspective of social geometry, i.e., social numbers and their significance in social life. It offers a generalized and interdisciplinary analysis of one as a social zero, then of social numbers two, three, and four, as well as of larger numbers. Furthermore, this article discusses the basic forms of sociality and special emphasis is put on qualitative changes that occur through quantitative changes in the social number of configurations. This is achieved through the accumulated scientific knowledge of human evolutionary history and its influence on human groupings. *[Social numbers, social geometry, social groupings, social thresholds, human groups]*

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Social Groupings and Social Numbers

Living in groups was a key feature of human evolution for several reasons, some of which are more obvious than the others. Scientists realized that one of the advantages of human life in groups is an easier protection from predators as well as the possibility to organize the hunting of big animals. Therefore, life in groups enabled survival during evolution, but it is clear that this way of human organizing also offered additional advantages to individual members of the group. Both the group and the community are the mediators for cultural transmission of information in addition to being a protective environment where the socialization of individuals takes place. For that reason some authors started discussing the importance of social brain and its role in the preservation of society (Jolly 1966; Humphrey 1976). It turned out that the social use of intelligence was of crucial importance for all social primates because the young depended on their respective groups for protection as well as the training for their future role in life. Since their dependence on the group demanded social learning and simultaneously enabled it, social integration and intelligence probably evolved together (Jolly 1966).[1]

The fact is that even within groups there has to be some differentiation that enables them to function as coordinated units and to conduct some basic tasks – to raise children, to find and secure food, and to establish ways and rules on the basis of which group

1 People are probably the most social animals because, despite the fact that some eusocial insects live in colonies which comprise millions of individual members, only *Homo sapiens* lives in such diverse social groups. Humphrey's (1976) emphasis of the importance of prediction and manipulation of behavior and mind of the members of one's own group has led to the development of the theory of mind as a very important concept of comparative and developmental psychology (Whiten and Byrne 1988).

cohesion can be maintained. These basic tasks have not changed much during human evolution, regardless of the fact that there have been various social arrangements throughout history, so one can speak of core configurations concerning social groupings (Caporael 1996, 1997). In other words, some configurations are core configurations because they repeatedly assemble in hunter-gatherer groups during evolution but also in human ontogenetic sequences and daily activities.

The significance of these configurations mainly comes from the relationship between physical limitations and the limitations imposed by the environment – one person can breastfeed a child at a certain moment, a small number of people can examine an object from a certain distance, etc. Such limitations suggest that there are natural limitations when it comes to the size of core configurations and the functions they perform. These configurations are stable despite (seeming) arbitrariness and they occur generation after generation as a consequence of the physical interaction between the species' morphology and ecology as well as their evolved cognitive processes. Therefore, social numbers represent a sort of "gravitational centers" towards which configurations ("magically") gravitate.

That is why in the context of this article it is necessary to understand the evolution of complex systems (including sociocultural evolution) as the evolution of their geometry, i.e., the geometry of the space of social interactions (Klüver 2003).[2] The arguments above do not suggest that the psychological characteristics of individuals are not significant, but this article will emphasize the quantitative aspects of sociality, i.e., the ways in which quantitative changes in social configurations lead to qualitative changes in the structures of the group and behavior of individuals. An important implication of social geometry and social numbers is the fact that our social world is not homogeneous and unlimited, but actually limited by social relations that are influenced by the size, i.e., the number, which is extremely important for its structure.

The first and probably the best-known analysis in sociology from the viewpoint of social geometry was done by Georg Simmel (2009 [1908]). In his formal sociology he insisted that sociology should not deal with the content of social life but with its forms. That is why he wrote about the significance of numbers in social life intending to show how form and internal life of the group are under the influence of its numerical relations. He understood that the sociological structure of the group is modified according to the number of individuals that are united in the group, which can be seen even in our daily experience – the increase in the number of group members must lead to certain forms of organization that did not exist in its earlier stages (when the group had less members). In this respect, Simmel's best-known analyses are those of dyads and triads, the basis on which many authors later wrote about various aspects of dyads, triads, small and large groups.

Many sciences deal with the issue of groups and grouping in social life but none of them can independently offer a fully satisfying analysis. This implies that we should strive to formulate a general theory of the evolution of (human) grouping, which is perhaps still a premature task. We can, however, discuss several "social numbers", i.e., the numbers of the members of the group, which are characteristic of human groups. For instance, recent research indicates that human social networks and the hierarchy of the size of human groups have a structure based on multiples of three (Zhou et al. 2005; Sutcliffe et al. 2012). In other words, this indicates that people probably form groups spontaneously and organize them according to geometrical series as well as that there are certain thresholds that regulate the size of human groups.[3]

One Equals Zero

An individual can be marked by number one although the adequacy of this account is questionable. Is it better to say that an individual represents a "zero" in the social sense and that the analysis of social numbers should start with number two? It is clear that society comprises interactions among individuals, but all individuals are part of the process of socialization and play a certain role in its continuation, which essentially continues the society itself. According to Durkheim (1982 [1895]: 45): "[I]n order for a social fact to exist, several individuals at the very least must have interacted together and the resulting combination must have given

2 This analysis from the perspective of social geometry should not be confused with some other programs, such as pure sociology and social geometry by Donald Black (e.g., Black 2002).

3 This idea has withstood some criticism, primarily because one can claim that this is an ecological fallacy according to which patterns observed throughout the population cannot apply to individuals within that population (Robinson 1950; Kraut and Rosenn 2012), and some authors also say that this kind of analysis ommits the role of leadership (as well as political hierarchies) and social identity, which actually mutually bind different levels of sociality (Van Vugt 2012).

rise to some new production." This means that individual consciousness is its necessary but insufficient condition.[4] Simmel says something similar on the first page of his "Sociology" (2009 [1908]: 19): "[E]very individual phenomenon is mainly determined through immeasurably immense influences from its social environment," which indicates the interconnectedness of elements that make up society.

American pragmatists also encouraged these presumptions. For Mead (1934), self is produced in a social process, so he interprets the behavior of individuals through the behavior of the group to which the individual belongs. As a starting point in understanding this theory, social act represents an activity which requires at least two people and which comprises roles, attitudes, meaningful speech, presuppositions about attitudes, and social objects. Just like Mead, Dewey (1922) stressed that the explanation of sociality should rather seek help in physics, chemistry, and physiology than in individual-oriented psychology. Baldwin (1909: 211) said a similar thing: "The individual is found to be a social product, a complex result, having its genetic conditions in actual social life. Individuals act together, not alone – collectively, not singly."

Sociologists later noticed that most social spaces are not organized for people who are alone, with some rare exceptions (e.g., counters in bars) which are accordingly labeled as signifiers of loneliness (Goffman 1971). In a similar manner, being alone in a public space often causes certain feelings of unease and an individual performs certain ritual actions to justify this state. Because of all these reasons Goffman (1963, 1967) paid special attention to the so-called unfocused interaction as the type of communication in which individuals exchange only random information. Namely, even when alone, an individual interacts with others.

For Berger and Luckmann social reality must constantly be created and recreated over again, which means that social world remains/is real only if it is continually confirmed. This happens in the social process because *others* must confirm this world as well. In their famous description of the sequences of objectivization, using a hypothetical scenario of a person on a deserted island, they emphasize that this individual acquires a range of habitualized behaviors appropriate for this new life until a new person appears in this context, when a dyad occurs. Only in this way, a dyad becomes a social institution and actors accept certain roles, combine their activities, and become a stable, predictable social unit with an appropriate division of labor (Berger and Luckmann 1966).[5]

Two

The study of dyads, which are the manifestation of the social number two, is very important for sociological and anthropological analyses, since dyads involve many structural conditions and social processes. Furthermore, the analysis of dyads demonstrates the weakness of psychological reductionism and in some cases the insufficiency of methodological individualism. This is primarily so because of qualitative changes that are the results of a quantitative change from one (as a zero in the social sense) to two.

Two is the smallest and basic social number and it is philogenetically the oldest social configuration, because it is necessary for reproduction. Dyadic interactions are also an initial and crucial relation for the survival of children. Among people and other primates dyads are not so important in the evolutionary sense because of these new capacities, but because this configuration functions in the initial social organization and in the "entrainment of biological clocks, rhythmicity, and temporal patterning" (Caporael 1996: 286). The basic organizing principles of all interactions are said to be synchrony, mimicry, and reflection, which are the basis of social contagion (Burgoon et al. 1995). Interactional synchrony has great significance for a functionally meaningful interaction, because processes like perception, memory, and attention are based on the synchronization of rhythmical patterns in the physical world with endogenic rhythmical processes of organisms.[6]

In its elementary form a dyad occurs when one participant enters the perceptual space of another person, while interdependence develops when both participants become aware of the presence, attention, and responsiveness of the other. When co-presence is established, both participants of the dyad take into consideration the anticipated reaction of the other while constructing and regulating their own behavior (Goffman 1963). That is, why it can be said that dyads are characterized by a relatively

4 This does not mean that we accept Durkheim's famous dictum: "[E]very time a social phenomenon is directly explained by a psychological phenomenon, we may rest assured that the explanation is false" (Durkheim 1982 [1895]: 129).

5 It is, however, important to emphasize that the authors do not support the view that an individual cannot be the unit of sociological analysis. We only suggest that one as a social number does not have a significant content and that it equals zero because of that in the context of this article.

6 Caporael (1996); Jones (1976); Jones and Boltz (1989).

permanent relationship, patterned common action, and a relationship with personal elements among the participants. In that sense, they are different from social relations which are primarily based on ascribed roles, not on personalities and personal interdependence (Thompson and Walker 1982).

Thus defined, a dyad has some very interesting implications, such as that its unit of analysis should be the relationship itself, i.e., the pattern between two people. Dyads are something qualitatively different and "more" than a mere sum of individual characteristics. Therefore, a dyadic analysis indicates the necessity of the cooperation between psychology and sociology/anthropology, because it is clear that the psychological characteristics of individuals are not enough for a complete explanation of social relations. In other words, the study of personal characteristics is not the same as the study of dyads, because the latter possess emergent characteristics.

The difference between individual characteristics and the characteristics of a relationship is very important since these are not the same. For example, people have opinions, values, and needs (which is, roughly speaking, a psychological level), while relationships are characterized by norms, rules, and power (which is, roughly speaking, a sociological level). Furthermore, an individual *outside* a certain relationship is not the same as an individual *in* a certain relationship, because that relationship depends on the other person as well (Becker and Useem 1942; Maguire 1999).

The dyad is different from other quantitative social groups, because each participant interacts with only one person, not with a collective. In order for such a group to survive, both participants must construct a reciprocal interaction with a high level of inclusion on both sides, which is why the dyad is very sensitive, "fragile," and more uncertain than other social units. It disintegrates as soon as one person leaves it, and since it is characterized by a reciprocal interaction and relatively equal inclusion, it often becomes egalitarian over time. This egalitarian element is increased by the tendency of both participants to treat each other as individuals, not through their categorial identity. However, that does not mean that the significance of status differences completely disappears in the dyadic interaction and there are even research studies that use the analysis of sounds and bodily movements to empirically verify the influence of the social status on microinteraction (Gregory 1994).

Therefore, a dyad does not contain any superindividual life which creates a sense of limitation among its members in other kinds of groups. This lack of a superindividual structure results in an intensive involvement of participants in the dyadic relationship. The dependence of the whole on its parts, i.e., on both partners, is obvious – in all groups, duties and responsibilities can be delegated except in dyads, where each participant is directly responsible for any kind of collective action. Since each partner in a dyad deals with only one individual, neither can negate the responsibility transferring it to the group nor can the group be held accountable for success or failure. In dyads there is a higher degree of individualization than in groups with more members and the key issue is the fact that in the set of two people there is no majority that can overpower an individual, except by a mere addition of one more member (Simmel 2009 [1908]).

In other words, a dyad comprises individuals that repeatedly enter successful interactions, and to make that possible focused attention and common emotions are necessary (Collins 2004). Participants thus occupy a momentarily separate, socially constructed reality and "charge" themselves with a sense of social solidarity which Collins (1990) calls emotional energy. This process usually includes a barrier towards outsiders who do not share that focus of attention and who can easily disrupt the intensity of interaction. Therefore, co-presence, joint action, stereotyped formalities, transient emotions, and a common mood lead to rhythmic synchronization and these cycles form collective effervescence and entrainment. These microrituals of friendship form symbols which are built on particularistic experiences – for example, the subjects of conversations become a kind of Durkheimian sacred objects and they symbolize the belonging to the dyad (Durkheim 1915 [1912]). For that reason it is common for self-disclosure to happen in the initial phase of a dyadic interaction. It enables participants to get to know one another and this common knowledge and exchange of emotions in interaction rituals are instrumental for the formation of a relationship between two people, which opens possibilities for the future. For instance, interactional synchrony is critical for courting and mating, because the lack of success in synchronization leads to the failure in the initiation of courting. For that reason, the fact that the same specialized function (microcoordination) can perform different tasks is an important implication of a dyadic configuration (Caporael 1997).

From all this follows that the intensity and a necessary frequency of interaction create conditions in which the participants of the dyad develop an intimacy that depends on the exclusivity of common knowledge and experience, i.e., on the fact that some things are shared only among its members. In

such circumstances they can become loyal to each other, which is a quality found in close friendships and romantic love. As some research show (Gregory 1983), the process of interaction between (these) members synchronizes the volume, pitch, tempo, accent, bodily movements, i.e., whole patterns of speech and body language, while electroencephalographs note synchronization between brain activities of people talking. What is particularly stimulating is the neurophysiological evidence for the mechanism of attraction in the sense of the Durkheimian feeling of collective effervescence – some individuals have an evolutionary imperative of seeking out macrosocial forms that generate a positive emotional experience (Hammond 2003). In other words, greater coordination and synchronization of a ritual interaction truly produce social solidarity, which in Durkheim's time was just a theoretical concept (Durkheim 1915 [1912]).

There are essentially at least three types of dyads. Pure dyad is the one where both members are free from obligation and responsibility. Both members answer only to the other member when it comes to the survival of the relationship and the world external to the dyad, including the passage of time, "disappears" in the interactions of pure dyad. Representative dyad occurs in a situation when one or both members are faithful to other social units. For that reason, the way of acting and reacting towards the other member of the dyad depends on their identities as the representatives of larger social units. For instance, sales managers of two companies who meet for lunch to discuss possible business arrangements constitute a dyadic interaction, but their interaction significantly differs from a pure form of two lovers who have lunch together. Dyads (and triads) are not necessarily composed of individuals, so one can also speak of superindividual dyads, which comprise larger social units such as families, organizations, tribes, or societies. In other words, larger social networks have a dyadic quality when they communicate with one another. This helps in understanding processes when two companies compete, two governments cooperate, and how coalitions are formed between political parties etc. (Miller 2007).

Three and Four

When number three, or a triad, is discussed, the classical Simmel's analyses are usually mentioned since they explicitly demonstrate that the transition from a dyad to a triad represents a qualitative and not just quantitative change. It can also be said that the transition from a dyad to a triad is more "dramatic" than a transition from a triad to a larger group – two individuals might make a first synthesis and a union as well as the first separation and an antithesis – whereas the occurrence of the third party signifies a transition, reconciliation, abandonment of an absolute antithesis and sometimes its founding (Simmel 2009 [1908]).

The importance of the triad for sociality is multiple and is reflected, among others, in the fact that a dyad is (constantly) characterized by the feeling that it can potentially cease to exist, while a triad has a sense of permanence. Unlike triads, dyads do not have an object that represents a relationship as a whole or a collective to its members. Furthermore, in a dyad affection can culminate in intimacy, whereas in a triad it is most often limited to its parts. The delegation of functions according to universalistic criteria cannot be easily accomplished in a dyad, but it can be achieved in a triad (Mills 1958). Since it lacks the diversity of mechanisms of reintegration, the dyad is more prone to decomposition than a triad due to the increased demands it faces.

In triads there is also a change in the interpersonal dynamics of the dyad and new social relations occur that were not possible in dyads. For example, an analysis of a sociometric structure of small groups has identified nine types of relations between two people and as many as 138 different relations among people in triads, i.e., different types of triads (Noma and Smith 1978). For that reason, the addition of the third member adds the mentioned superindividual character to the group – if one member leaves, the group still exists, and if a new third member appears later, group activities do not have to change much. In the same manner, the addition of the third person makes the dyadic co-presence and behavior public, which can jeopardize intimacy. This situation also occurs when, for example, a couple has a child and then loses a large part of their previous intimate reciprocity. If the third member is just a stranger or a co-present person, then an element of surveillance or voyeurism can appear. If the third person is known to the members of the dyad, he/she can be invited to join them or can be treated as an unwanted intruder who is not only distant from the triad but also alienated from the dyad and interaction (Miller 2007).

Hence, under some circumstances a "leap" from a dyad to a triad empowers the original couple (e.g., a child often brings parents closer together), while in some others it separates them (e.g., a girl separates two friends). The characteristics of dyads can be approached precisely through the analysis of the ways in which they treat and absorb the newcomer (Mills 1958). In other words, handling the change of

numbers can be an excellent indicator of the characteristics of a couple. For instance, it is possible to ask how the attributes of couples affect the dynamics of accepting new members, and what kinds of dyads are prone to a union with the third member, and what kinds refuse this integration?

A triad is, therefore, the simplest structure in which a group as a whole can dominate its members and in which it is possible to limit individual participants for collective purposes. A dyad relies on an immediate reciprocity, but a triad can impose its will on the participants through the formation of a coalition between the other two members. Simmel (2009 [1908]) described three forms of interaction which occur when a triad is formed: *divide et impera*, *tertius gaudens*, and impartial mediator. Using the strategy *divide et impera*, a third individual can intentionally create a conflict between the other two individuals to secure a dominant position or other kinds of gains. In addition, a third individual can act as a *tertius gaudens* and benefit from discord between the other two members. And finally, a third member can play the role of a *mediator* between the other two members and impartially try to calm emotions that threaten to jeopardize the group.

Furthermore, an example of a triad, i.e., the addition of a third member to a dyad, also demonstrates weaknesses of extreme psychological reductionism because its features surpass mere psychological characteristics of three individuals. Many authors after Simmel wrote about these relationships in a triad, mostly about the idea of *tertius gaudens* and coalitions in small groups. For instance, Burt (1992) speaks of two *tertius* strategies – being a third party between two or more players who have the same positions and being a third player among players who have different positions and opposing demands. The essence of these analyses is the fact that in triadic relationships there is a lot of tension which can be used by someone, because without tension there is no *tertius*.

For Berger and Luckmann (1966) a leap from a dyad to a triad also has significant social consequences. For instance, the product of a reciprocal typification of a habitualized activity of man and woman is a child, which represents a change in the quality of the group. What used to be an *ad hoc* and informal institution of husband and wife is now transformed into a historical institution with a more crystalyzed objectivity, because institutions transcend any individual. The objectivity of the outside world "toughens" and "strengthens," not only for the children (i.e., the second generation) but also for the parents (i.e., the first generation). Now the sentence which describes the beginning or the foundation of institutions, "Here we go again," changes to "This is how things are done." After a triad, with the birth of another child, there is a tetrad and in time the members of the original dyad get new roles (e.g., grandparents). With the arrival of new people and the death of original members of the dyad, there is an acceptance of an incorporeal "we-intentionality" (Searle 1995; Plotkin 2003) and the institutions they created continue to exist.

When it comes to coalitions, their formation is connected with the control by the majority. Besides Simmel's analyses, the ideas of John von Neumann and Oskar Morgenstern (1953 [1944]) are very important, as well as the ideas of John Nash (1951). In sociology and psychology it is presumed that the formation of coalitions is influenced by the number of participants in a system, with a triad being the most studied. Coalitions in triads have certain features which are very useful for the analysis of relationships of power inside organizations and among them. Besides that, tetrads, pentads, and larger systems can be analytically observed as clusters of connected triads.

The greatest number of theoretical and empirical research studies discusses three types of coalitions: (1) $A > B > C$, $A < B + C$ (A and B will prefer C as a coalition partner and its initial weakness secures the participation in the winning coalition); (2) $A = B$, $B > C$, $A < B + C$ (the initial weakness of C often leads to the fact that it is the winner); (3) $A > B$, $B = C$, $A < B + C$ (B and C will prefer each other as coalition partners, while the initial strength of A excludes it from the winning coalition).[7] Since in a dyad an individual cannot be overruled by the majority, this implies that coalitions are only possible in triads.

However, there are certain qualitative differences between triads and tetrads and probably the most important one is the possibility of counter-coalitions, which first occur at the level of tetrads. Thus, the weakest member can rarely be strong in a tetrad (since he is too weak), while his strength in a triad can be a frequent situation. Another difference lies in the fact that in a tetrad the size of a coalition becomes important (Willis 1962). This short review makes clear that the study of dyads and triads (as well as of tetrads) is relevant for many fields of social sciences, including negotiation and settlement, counseling and psychotherapy, courtship, marriage and family, conversation analysis, leadership, obedience, politics, etc.

7 See Mills (1953); Caplow (1956); Gamson (1961). – Caplow (1956) actually analyzed eight possibe kinds of coalitions, but these three are the most frequently analyzed ones.

Five to Fifteen

Social numbers larger than two, three, or four, i.e., the ones that roughly include numbers from five to fifteen, possess significant distinctive features. Although it is not yet possible to strictly analyze or demonstrate what precisely happens when a group gets a new member (a transition from four to five members, from five to six, etc.), it is possible to show the differences between groups with a small number of members and groups with a large number of members (Simmel 2009 [1908]). In many cases, the structure of the group is from the very beginning adjusted to the changes that originate in the group and which are produced by its constituents. When a new member enters the structure of a group, it can be preserved in two ways: by maintaining the firmness and rigidity of the form so it can face the threats and dangers, i.e., preserve the relationship of its elements despite the changes of external conditions, and through the greatest possible variability of its form, so the adaptation of the form can quickly be achieved in a reaction to the changes of external conditions, and the form of the group can be adjusted to the "demands" of circumstances (Simmel 2009 [1908]).

When social numbers are concerned, "little" is defined as enough for all members to simultaneously interact, talk with one another and at least know one another. Besides that, there must be a feeling of belonging to the group, i.e., a differentiation of "us" and "them" (Back 1981). With this in mind, work/family groups are in part a result of division of labor in a larger entity and they are part of dynamic processes of differentiation in larger groups (Caporael 1997). If a family is defined as a group, its main characteristic is the extension of an individual through time, because that is how biological, social, and cultural features are transmitted. Work groups, which are also marked as small groups, function through spatial closeness that allows individuals to achieve their goals, but with concerted action.

Like dyads, work/family groups cannot survive independently and reproduce. Sometimes these groups used to have a direct interactive contact with a habitat (in the time of hunter-gatherers), so from the evolutionary perspective a relevant task of this group was not hunting or collecting fruit *per se* but a collection of social cognitive processes that enable hunting and gathering or a direct interaction with a habitat. These processes can be strengthened by the group and (under certain conditions) they can be weakened if the group is too big. A work/family group configuration enables distributed cognition which is focused on a task or a problem – the division of cognitive resources like memory, perception, motivation, even bodily coordination. It is also a primary locus for repeated assembly of culture between generations, because that is where children learn how to become adults.

It is interesting that in this context Moreno (1947 [1936]) spoke of the so-called social atom, which for him was the smallest social unit that was not an individual. It comprised an individual and people (close or not) with whom he/she had an emotional attachment in a certain time period. In other words, this is a nucleus of people who are emotionally attached to the subject that contains an external and an internal nucleus. The external nucleus is the person with whom a relationship is wanted or desired and the internal nucleus is the person with whom a relationship is regularly accomplished. This number should not be confused with the total number of acquaintances that a person has. It only refers to the individuals that "mean something" to the subject. Moreno also insisted on the theoretical importance of the point of transition from being a mere acquaintance to becoming an emotional partner in the social atom, calling this boundary a "social threshold."

Specific numbers for this form of sociality are five to fifteen. Namely, the social number 15 is noticed even by researchers of small groups in psychology (Argyle 1952) and the group of 15 people is known as a "sympathy group" (these are, for example, people whose death would affect us greatly). The average size of such a group, i.e., the number of people an individual has emotional ties to, is 10.9 members, which implies a limited capacity for human compassion (Buys and Larson 1979). The basic feature of this social number is that a certain number of people start interacting after a while and that all individuals are aware of all other individuals. Furthermore, the size of teams in many sports, the number of jurors, the number of apostles, etc. can all be placed between the numbers five and fifteen.

The threshold of optimal size for a small discussion group is five members, because members are mostly dissatisfied in smaller or larger groups – in small ones they are forced to be too prominent and in larger ones they might not have enough opportunities to express their opinion. In a group of five members, it is possible to avoid delays or dead ends and the members can easily and quickly change their roles. In addition, it is important to note the phenomenon of subgroups, i.e., the fact that what often matters is not the *real* size of the group but its *functional* size (Hare 1981).

With the increase in the number of members of a small group from three to eight there is also increase in the number of those who do not participate

in its work, which is why the functional size of the group is smaller than its real size (Bales et al. 1951). This is because the number of possible symmetrical relationships among pairs of members increases much faster than the number of members added to the group – besides the relationships among pairs there are also relationships among each member of the group and the group as a whole. If members of a group participate for a while in an interaction whose time is fixed, the addition of new members causes changes in the nature of existing relationships and limits the number and nature of new relationships (e.g., the time available for each member, the degree to which the conversation is reciprocal, etc.) (e.g., Bales 1950).

Kosse (2000) also notices a certain tension when the size of the group exceeds six individuals and that in the *n*-person prisoner's dilemma there is a breakdown of reciprocity in groups larger than 6 to 10 individuals. Specially designed research studies that measure interactions in formal organizations reveal that an average number of immediate people for an individual communication is 7.27 people and that this number is most likely the consequence of the limitation of human short-term memory (Miller 1956). This number also corresponds to the social number of a smaller group, i.e., the number that is roughly between five and fifteen.

Although different theoretical models imply various numbers of subgroups in a system, empirical evidence suggests that the number of large groups among humans is smaller, i.e., that it remains constant regardless of the increase in the size of the system (Kosse 2000). In other words, although the number of subgroups constantly increases via the increase of the number of elements, the number of hierarchical levels remains constant, probably around seven. This is also most likely the consequence of limitations in human short-term memory, which itself is probably the result of a long-term selection for a relatively quick response to external fluctuations.

From 25 to 50

It can be noticed, that in this article there is a certain gap between the social numbers 15 and 25, which is no accident. This is because there are assumptions concerning critical thresholds in the formation and evolution of the human group, which are most likely based on the regularities in the human system of information processing. These thresholds are the same in most classificatory schemes, independent from content and cross-cultural differences. One of these thresholds is the "magic" number 25 (Kosse 2000), although its existence is yet to be confirmed.

It is known that foraging bands on average have 25 to 50 members, which is the reason why the size of the band itself is referred to as "magical." This number has remained relatively constant independent of the historical period (from the Pleistocene until today), availability of resources among the population, and the density of population (Caporael 1997). The group of 25 to 50 corresponds to a typical size of an overnight camp of hunter-gatherers and the stability in the size of the band (and their efficiency in comparison with the available food) implies that in the explanation of these "magic" numbers we must include both social and psychological factors. The average size of the population in the societies of hunter-gatherers was around 40 and they appear about 100.000 years ago. Due to this fact, it can be concluded that this number of people was optimal during a huge period of human evolution (Nolan and Lenski 2009). This is supported by the fact that tribes in present-day Australia are composed of a larger number of such groups of 40 members (on average) who are united by a common dialect and a similar culture (Birdsell 1953).

Therefore, in traditional hunter-gatherer groups, the band is the first configuration which is self-sustainable when it comes to survival and child rearing (but not reproduction), and this is also a basic economic unit. Caporael (1997) calls the configuration of this approximate size a "deme" and it includes the coordination of a work/family group as well as the construction of reality (common knowledge) which can be mythical, adjusted to local conditions, focused on other people, local ecology, etc. Demes enable cooperative alliances which are the basis of the process of fission when the community becomes too large for available resources, or when there is a conflict inside it. In the societies of hunter-gatherers fission almost never happens under number 80 or until the community reaches the size that can be divided into two sustainable villages of about 40 members (Chagnon 1997 [1968]). In a contemporary society, a deme can be compared to the extended family with several generations, but it also exists in the context of modern institutional or bureaucratic group configurations. Modern demes most often differ from traditional ones in the fact that they do not include embedded aspects of a hierarchical structure.

Even Simmel (2009 [1908]) claimed that the "leap" of the group towards a larger social number resulted in the occurrence of interactions that must be mediated by formal arrangements. In other words, in order to enable the survival of increasing-

ly complex groups and relationships within them, the group must create special organs that would help shape interactions among members. No large group can function without a differentiation of status positions and the division of tasks and responsibility, so for these reasons larger groups become the societies of the unequal individuals. In order for them to survive, they must be structurally differentiated. However, a larger group acquires its unity, which is expressed in group organs and political ideals and ideas, only at the price of a large distance between all these structures and an individual.

For Bales (1950), as the group grows from a smaller towards a larger number, it begins to accept a more direct and organized approach to information search, which increases the chances that a leader will occur and be elected. In addition, the differences in the quantity of communication decrease when it comes to the members of the group and communication is increasingly directed towards the group as a whole. Besides that, what grows is the number of members who have minimum participation through mere listening and emotional reaction. The larger the group, the greater the potential conflict, i.e., it is less likely for the members of the group to agree on a controversial issue. The conformism of the group also diminishes, so group members become less satisfied with the group and its activities. In brief, consistent behavioral differences occur at different levels of social geometry and numbers.

All this means that the group of a smaller social number is characterized by a larger inclusion of its members, because interaction in a small group is more intensive than interaction among several individuals, if for no other reason than for the frequency of contact. Besides that, groups with a smaller number of coalition members and majorities that limit individuals originate in the immediacy of participation. Furthermore, the systems with fewer members usually burn all their energy while the larger ones maintain their residual strength. A more serious disturbance in small systems results either in solidification or in a collapse, while larger systems are usually reduced to bipartite systems. On the other hand, small groups have means to resolve complex conflicts among individuals, while larger groups have a better control over conflicts among organized subunits. It is important to mention that small, non-differentiated groups do not have the element that mediates between the individual and collective (Mills 1958). Therefore, differentiated organs in a larger group limit the individual through its "objective" power, although they allow the liberation from the group due to a segmentary (and not a total) inclusion. This means that large numbers paralyze individual elements and influence the fact that general elements occur at such a large distance from individuals that they think general elements could exist on their own, without individuals. In addition, these general elements are most often antagonistic towards individuals.

150 and More

Dunbar's research shows that we can talk about human groups of 150 members, which is supposedly the upper limit of the number of social relations people can have (1992). This is also a new "magic" number, which fits the hypothesis on the causes of the size of human brain, which is called the hypothesis on the significance of human relations or Machiavellian intelligence (Whiten and Byrne 1988). According to this theory, primates differ from all other animals with respect to the complexity of their social relations, which is supported by a strong correlation between the mammalian group size (complexity of the social world) and a relative size of the neocortex (Pérez-Barbería, Shultz, and Dunbar 2007). That means, that there is a limit concerning the number and quality of relations that some species of animals can simultaneously pursue.

When humans are concerned, the social number 150 corresponds to a clan, which has a primarily ritual significance reflected in periodical celebrations and participation in various rituals. Data indicates that the average size of the clan is 153 (i.e., between 100 and 230), and the number 150 represents the size of many villages in traditional and historical societies, and also the size of a military company in most modern armies (Sutcliffe et al. 2012). One research (concerning the exchange of Christmas cards) also indicates that a maximum number in the social network, defined as the circle of friends, relatives, and acquaintances with whom people have regular contact (at least once a year), is 153.5 individuals (Hill and Dunbar 2003).

Research also shows that these limitations are connected with information constraint concerning the quality of relations in question. Simply put – for monkeys, apes, and humans the quality of relationships is important as well, not just their absolute number (Granovetter 1973; Maryanski 1987). It has been shown that the groups of 150 or 200 members have a tendency to become hierarchical in structure because organizational relations become more complex. In other words, in a population of over 150 individuals, daily interaction becomes segmented and the flow of information becomes regulated

through more formal ritual channels (Dunbar 2010; Kosse 1990). Clans are especially interesting in this sense because they are usually affiliated with the same ritual function. Also, they are the largest group in which everyone knows everyone else, not in the sense of knowing who is who, but who is related to whom or in some different kind of a relationship.

In respect of size, tribal groups are larger than clans and they usually have between 200 and 1,500 members (Sutcliffe et al. 2012). The question is why people would rather group in approximately ten communities of around 150 people than in one community of 1,500 people. Anthropologists usually presuppose, at least for egalitarian "primitive" societies, that it is ecologically more efficient to divide the population into smaller groups. These societies are organized via kinship, marriage, and common ancestry. Chagnon (1976) also claims that there are intrinsic limitations with regards to the size of groups organized in accordance with these three principles. He emphasizes that the Yanomami would divide even more often if they could, but they cannot afford that because of potential warfare. In communities, which often wage wars, a community of 150 members will probably not fall apart because smaller groups are more vulnerable. As villages form mutual political alliances, their structure becomes more complex because the exchange of women decreases the amount of kinship inside a group. It can be said, that this division is most often a result of gradual accumulation of tensions within the village, since the increase of group complexity leads to more complex relations. It also leads to intensification of sexual intrigues, arguments, fights, and conflicts, so at one point the village cannot sustain itself through kinship relations, marital obligations, and a leader's authority (Chagnon 1997 [1968]; 1976).

Formally speaking, 150 is probably the upper limit of the number of individuals we can know as persons and with whom we have a defined social relationship. Consequently, this is the upper limit of the social numbers in a strict sense. For Dunbar (2008) this is a cognitive limit and the individuals from the "circle of 150" are characterized by a certain level of reciprocity and obligations which we do not ascribe to individuals beyond this critical "magical" circle. There is a lot of evidence that the size of the human social group has a cognitive limit, but that does not mean that people cannot live in large-scale societies (because they obviously do nowadays). This only implies that these are not "natural" social units for the modern man. These kinds of groupings far exceed the capacity of an individual to know and understand all the members of a configuration as individuals, which is why they need different strategies to maintain their coherence over time (e.g., legal system, police, etc.). These ideas were certainly the object of criticism, so Wellman (2012) claims that it is quite unlikely that human cognitive capacities limit people to 150 meaningful relationships, i.e., that these numbers are much bigger.

For the conceptualization of larger social numbers it is possible to introduce the concept of "macrodeme," which ends and completes the cycle of biological and social reproduction. The evolution of macrodemes enabled the stabilization and standardization of language in order to allow the communication about distant events. In the historical sense, macrodemes are transitional core configurations, characteristic for villages and the dominant organizational structure for about 15,000 years. This means, that it is composed of between 500 and 1,500 individuals and its key characteristics are property and agriculture, marriage and religion. Macrodemes still exist, but they are rooted in a wider culture (Caporael 1997), while the threshold of 500 in human groups is suggested by research on the size of the community, as well as some everyday practices. For example, it is usually said, that the number of pupils in a primary school should not exceed 500, or that some churches divide into smaller groups when they exceed this number, etc. (Kosse 1990).

According to Nolan and Lenski (2009), in simpler horticultural societies an average size of the population was 1,500 and they first appeared over 10,000 years ago, i.e., around 8000 B.C. In advanced horticultural societies, an average size of the population was around 5,250 and they first appeared around 4000 B.C. Agrarian societies appeared around 3000 B.C. and the size of their population was approximately 100,000, while industrial societies appeared around the year 1800 with an average population of around 17,000,000. However, even if the size of the political community grows to several million people, the regulatory body at the top stays relatively small, i.e., in chiefdoms and archaic states leadership remains limited to the hereditary elite. Therefore, the threshold of 500 individuals, based on the limitations of human information processing, is significant even in more complex societies (Kosse 1990). Namely, 500 is also a "magical" number (Hunn 1994) as a modal size of a basic demographic unit among hunter-gatherers (see also Birdsell 1953; 1958). This is a unit which has important social, demographic, and genetic implications for human evolution and it is possible to speculate that this is valid for units from 200 to 800 people (Hunn 1994). A continuous growth leads to the point in which the system either disintegrates

or develops new coordinating units of a limited size. Empirical evidence suggests that this point is reached when the total size of the community exceeds 2,000–3,000 people (Kosse 2000).

Finally, the robustness of number 150 as a social number implies that numbers larger than that are possible only through the imposition of a structural organization based on language (Dunbar 2008), i.e., the signification of people as members of certain categories (professors, doctors, police officers, etc.). It is well-known, that the growth of specialization and organizational structures increases in a linear way, as the size of the community increases (Kosse 1990). Social geometry discussed in this article, or the rough thresholds of human grouping that were specified, imply that man is capable of maintaining a limited number of connections at a certain level of emotional intensity. Regardless of whether these limitations are the product of cognitive structures, limitations in resources like time or something else, social numbers and social geometry prove to be the inevitable fact of great significance for numerous sociological and anthropological analyses.

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References Cited

Argyle, Michael
1952 Methods of Studying Small Social Groups. *British Journal of Psychology* 43: 269–279.

Back, Kurt W.
1981 Small Groups. In: M. Rosenberg and R. H. Turner (eds.), Social Psychology. Sociological Perspectives; pp. 320–343. New York: Basic Books.

Baldwin, James Mark
1909 The Influence of Darwin on Theory of Knowledge and Philosophy. *Psychological Review* 16: 207–218.

Bales, Robert F.
1950 Interaction Process Analysis. A Method for the Study of Small Groups. Cambridge: Addison-Wesley Press.

Bales, Robert F., Fred L. Strodtbeck, Theodore M. Mills, and **Mary E. Roseborough**
1951 Channels of Communication in Small Groups. *American Sociological Review* 16/4: 461–468.

Becker, Howard, and **Ruth H. Useem**
1942 Sociological Analysis of the Dyad. *American Sociological Review* 7/1: 13–26.

Berger, Peter L., and **Thomas Luckmann**
1966 The Social Construction of Reality. A Treatise in the Sociology of Knowledge. London: Penguin.

Birdsell, Joseph B.
1953 Some Environmental and Cultural Factors Influencing the Structuring of Australian Aboriginal Populations. *The American Naturalist* 87/834: 171–207.
1958 On Population Structure in Generalized Hunting and Collecting Populations. *Evolution* 12/2: 189–205.

Black, Donald
2002 Pure Sociology and the Geometry of Discovery. *Contemporary Sociology* 31/6: 668–674.

Burgoon, Judee K., Lesa A. Stern, and **Leesa Dillmann**
1995 Interpersonal Adaptation. Dyadic Interaction Patterns. Cambridge: Cambridge University Press.

Burt, Ronald S.
1992 Structural Holes. The Social Structure of Competition. Cambridge: Harvard University Press.

Buys, Christian J., and **Kenneth L. Larson**
1979 Human Sympathy Groups. *Psychological Reports* 45/2: 547–553.

Byrne, Richard W., and **Andrew Whiten** (eds.)
1988 Machiavellian Intelligence. Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans. Oxford: Clarendon Press.

Caplow, Theodore
1956 A Theory of Coalitions in the Triad. *American Sociological Review* 21/4: 489–493.

Caporael, Linnda R.
1996 Coordinating Bodies, Minds, and Groups. Evolution and Human Social Cognition. *Journal of Social and Evolutionary Systems* 19/3: 261–275.
1997 The Evolution of Truly Social Cognition. The Core Configurations Model. *Personality and Social Psychology Review* 1/4: 276–298.

Chagnon, Napoleon A.
1976 Fission in an Amazonian Tribe. *The Sciences* 16/1: 14–18.
1997 Yanomamö. The Fierce People. New York: Harcourt Brace. [5th Ed.; Orig. 1968]

Collins, Randall
1990 Stratification, Emotional Energy, and the Transient Emotions. In: T. D. Kemper (ed.), Research Agendas in the Sociology of Emotions; pp. 27–57. Albany: State University of New York Press.
2004 Interaction Ritual Chains. Princeton: Princeton University Press.

Dewey, John
1922 Human Nature and Conduct. An Introduction to Social Psychology. New York: Holt.

Dunbar, Robin I. M.
1992 Neocortex Size as a Constraint on Group Size in Primates. *Journal of Human Evolution* 22/6: 469–493.
2008 Cognitive Constraints on the Structure and Dynamics of Social Networks. *Group Dynamics. Theory, Research, and Practice* 12/1: 7–16.
2010 How Many Friends Does One Person Need? Dunbar's Number and Other Evolutionary Quirks. Cambridge: Harvard University Press.

Durkheim, Émile
1915 The Elementary Forms of the Religious Life. A Study in Religious Sociology. London: George Allen & Unwin. [French Orig. 1912]

1982 The Rules of Sociological Methods and Selected Texts on Sociology and Its Method. London: Macmillan. [French Orig. 1895]

Gamson, William A.
1961 A Theory of Coalition Formation. *American Sociological Review* 26/3: 373–382.

Goffman, Erving
1963 Behavior in Public Spaces. Notes on the Social Organization of Gatherings. New York: Free Press.
1967 Interaction Ritual. Essays on Face-to-Face Behavior. Garden City: Doubleday.
1971 Relations in Public. Microstudies of the Public Order. New York: Basic Books.

Granovetter, Mark S.
1973 The Strength of Weak Ties. *The American Journal of Sociology* 78/6: 1360–1380.

Gregory, Stanford W., Jr.
1983 A Quantitative Analysis of Temporal Symmetry in Microsocial Relations. *American Sociological Review* 48/1: 129–135.
1994 Sounds of Power and Deference. Acoustic Analysis of Macro Social Constraints on Micro Interaction. *Sociological Perspectives* 37/4: 497–526.

Hammond, Michael
2003 The Enhancement Imperative. The Evolutionary Neurophysiology of Durkheimian Solidarity. *Sociological Theory* 21/4: 359–374.

Hare, A. Paul
1981 Group Size. *American Behavioral Scientist* 24/5: 695–708.

Hill, Russell A., and **Robin I. M. Dunbar**
2003 Social Network Size in Humans. *Human Nature* 14/1: 53–72.

Humphrey, Nicholas K.
1976 The Social Function of Intellect. In: P. P. G. Bateson and R. A. Hinde (eds.), Growing Points in Ethology; pp. 303–317. Cambridge: Cambridge University Press.

Hunn, Eugene
1994 Place-Names, Population Density, and the Magic Number 500. *Current Anthropology* 35/1: 81–85.

Jolly, Allison
1966 Lemur Social Behavior and Primate Intelligence. *Science* 153/3735: 501–506.

Jones, Mari Riess
1976 Time, Our Lost Dimension. Toward a New Theory of Perception, Attention, and Memory. *Psychological Review* 83/5: 323–355.

Jones, Mari Riess, and **Marilyn Boltz**
1989 Dynamic Attending and Responses to Time. *Psychological Review* 96/3: 459–491.

Klüver, Jürgen
2003 The Evolution of Social Geometry. Some Considerations about General Principles of the Evolution of Complex Systems. *Complexity* 9/1: 13–22.

Kosse, Krisztina
1990 Group Size and Societal Complexity. Thresholds in the Long-Term Memory. *Journal of Anthropological Archaeology* 9/3: 275–303.

2000 Some Regularities in Human Group Formation and the Evolution of Societal Complexity. *Complexity* 6/1: 60–64.

Kraut, Robert E., and **Itamar Rosenn**
2012 Comment on Relationships and the Social Brain. Integrating Psychological and Evolutionary Perspectives. *British Journal of Psychology* 103/2: 169–173.

Maguire, Mary C.
1999 Treating the Dyad as the Unit of Analysis. A Primer on Three Analytic Approaches. *Journal of Marriage and Family* 61/1: 213–223.

Maryanski, Alexandra R.
1987 African Ape Social Structure. Is There a Strength in Weak Ties? *Social Networks* 9/3: 191–215.

Mead, George Herbert
1934 Mind, Self, and Society. From the Standpoint of a Social Behaviorist. (Ed., with Introd. by C. W. Morris.) Chicago: University of Chicago Press.

Miller, Dan E.
2007 Dyad/Triad. In: G. Ritzer (ed.), The Blackwell Encyclopedia of Sociology; pp. 1264–1267. Malden: Blackwell Publishing.

Miller, George A.
1956 The Magical Number Seven, Plus or Minus Two. Some Limits on Our Capacity for Processing Information. *Psychological Review* 63/2: 81–97.

Mills, Theodore M.
1953 Power Relations in Three-Person Groups. *American Sociological Review* 18/4: 351–357.
1958 Some Hypotheses on Small Groups from Simmel. *American Journal of Sociology* 63/6: 642–650.

Moreno, Jacob L.
1947 Organization of the Social Atom. *Sociometry* 10/3: 287–293. [Orig. 1936]

Nash, John
1951 Non-Cooperative Games. *Annals of Mathematics* 54/2: 286–295.

Neumann, John von, and **Oskar Morgenstern**
1953 Theory of Games and Economic Behavior. Princeton: Princeton University Press. [3rd Ed.; Orig. 1944]

Nolan, Patrick, and **Gerhard Lenski**
2009 Human Societies. An Introduction to Macrosociology. Boulder: Paradigm Publishers. [11th Ed.]

Noma, Elliot, and **D. Randall Smith**
1978 SHED. A FORTRAN IV Program for the Analysis of Small Group Sociometric Structure. *Behavior Research Methods & Instrumentation* 10/1: 60–62.

Pérez-Barbería, Francisco Javier, Susanne Shultz, and **Robin I. M. Dunbar**
2007 Evidence for Coevolution of Sociality and Relative Brain Size in Three Orders of Mammals. *Evolution* 61/12: 2811–2821.

Plotkin, Henry C.
2003 We-Intentionality. An Essential Element in Understanding Human Culture? *Perspectives in Biology and Medicine* 46/2: 283–296.

Robinson, William S.
1950 Ecological Correlations and the Behavior of Individuals. *American Sociological Review* 15/3: 351–357.

Searle, John R.
1995 The Construction of Social Reality. New York: The Free Press.

Simmel, Georg
2009 Sociology. Inquiries into the Construction of Social Forms. (Transl. and Ed. by A. J. Blasi, A. K. Jacobs, M. Kanjirathinkal; Introd. by H. J. Helle.) Leiden: Brill. [German Orig. 1908]

Sutcliffe, Alistair, Robin I. M. Dunbar, Jens Binder, and **Holly Arrow**
2012 Relationships and the Social Brain. Integrating Psychological and Evolutionary Perspectives. *British Journal of Psychology* 103/2: 149–168.

Thompson, Linda, and **Alexis J. Walker**
1982 The Dyad as the Unit of Analysis. Conceptual and Methodological Issues. *Journal of Marriage and Family* 44/4: 889–900.

Van Vugt, Mark
2012 The Missing Link. Leadership, Identity, and the Social Brain. *British Journal of Psychology* 103/2: 177–179.

Wellman, Barry
2012 Is Dunbar's Number up? *British Journal of Psychology* 103/2: 174–176.

Willis, Richard H.
1962 Coalitions in the Tetrad. *Sociometry* 25/4: 358–376.

Zhou, Wei-Xing, Didier Sornette, Russell A. Hill, and **Robin I. M. Dunbar**
2005 Discrete Hierarchical Organization of Social Group Sizes. *Proceedings of the Royal Society – Biological Sciences* 272/1561: 439–444.