

Like Water and Vapor--Conformity and Independence in the Large Group

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Abstract

Conformity and independence in the large group may, in part, be due to collective phenomena analogous to those producing different physical phases like solid, liquid and vapor. This phase model of the large group explains several previous anecdotal observations: It predicts a suddenness in the decision making, it explains the apparent contradiction between crowd suggestibility on the one hand and the difficulty of controlling a crowd on the other hand, and it provides a new rationalization for the phenomenon of splitting. The model is of use to both leaders and members of the large group. For example, it suggests what social parameters to change to disperse a violent crowd, and why crowd crystals, a concept examined by the writer Canetti, can suddenly make the large group conform.

Key words: Collective phenomena, large group, crowd, phases, phase transitions, conformity.

Like Water and Vapor--Conformity and Independence in the Large GroupIntroduction

One hundred years ago Le Bon (1895) wrote, in his famous book on crowds: "The substitution of the unconscious action of crowds for the conscious activity of individuals is one of the principal characteristics of the present age." Large groups with people acting in unison can be powerful catalysts for the good as well as for the horrible. Examples of the former include the destruction of the Berlin Wall, the wearing of stars of David by the non-Jewish population in Denmark during the Holocaust, and the civil rights movement in the U.S. Examples of the latter are the Nazi era in Germany, the recent mass-killings in Rwanda, and the self-decimation of the Xosas in South Africa (Canetti, 1960).

The concepts of phases and phase transitions originate in the physics of materials. The phases of water, for example, are ice, liquid and vapor. These phases have qualitatively different behaviors. Liquid water flows, vapor disperses, ice cracks. If one examines these phases on the atomic level one finds that the water molecules themselves do not undergo any individual changes, rather the phases correspond to different collective states of the water molecules. In the vapor phase the water molecules are free to move in any direction, in the liquid phase they are strongly attracted to the neighboring molecules but still move in all directions. In the ice phase, finally, the water molecules no longer move around, they only vibrate around an average position, and are lined up along a few special directions. Phase transitions are changes in the phases and the corresponding collective states; for example the freezing of liquid into solid, and liquid turning into vapor. Magnets being magnetized, and a material becoming superconducting are also phase transitions. In these the collective states involved are those of electrons rather than of molecules.of collective states of electrons.

This paper suggests that just like materials--which are groups of electrons, atoms, and molecules-- , the large group--of animals or people--can have different phases. Two examples of phases of large groups will be given: In the relatively individual phase, people do not care what other people do, just like water molecules in the vapor phase are free to move in any direction. In the relatively conforming phase, people in a group conform their behavior just like water molecules in ice line up in the same direction. Just as in the materials example, no intra-individual changes need occur, only inter-individual collective states change. While much of the particular behavior of single molecules is impossible to predict in aggregate systems with enormous numbers of particles, the properties of phases and phase transitions are global in scope and are relatively independent of the details at the level of the individual element. Analogously even though people are individually very hard to predict, it may be possible to predict some of the collective behavior of large groups.

The author is not the first to make use of collective phenomena from physics in social theory, and the reader is guided to Helbing (1993) for an earlier such perspective. For a book on the physics of phase transitions the reader is recommended Stanley (1971), for a review of crowd behavior see McPhail (1991).

### Large Group Phases

#### The Relatively Individual Phase

Since society affects individuals at all times it is impossible to come up with an example of a large group of completely independent people. However, relatively, on one of more dimensions (McPhail, 1991, stressed the need for a defining and limiting dimension when considering collective behavior) it is possible to find an relatively individual (RI) phase (see Table 1). For example, a crowd gathered in a square before the speaker has arrived will have individuals face all directions rather than align in the direction of the speaker. Similarly we have German society before Nazism took over, Rwanda before the collective killings started, and an army before it is commanded.

### The Relatively Conforming Phase

There are many examples of large groups making up a relatively conforming (RC) phase (similar to McPhail's "collective behavior-in-concert"). In Table 1 we find the marching army, people in church, scientists during a ruling paradigm (see below), lemmings marching and birds migrating. Other examples are rule obeyers in a bureaucracy, conformists in a lynch mob and herds of animals moving in unison across the African savanna.

### Large Group Phase Transitions

One particular phase transition one can sometimes see at Tavistock group experiential conferences: similar emotions will suddenly overtake the expression of group members. It can start with a single expression of strong sadness and very quickly the group becomes quiet. Other members start to conform and express similar sadness and dissimilar types of behavior become punished. Another example of a system of people that has phases and undergoes phase transitions is the science community. Thomas Kuhn (1970) describes the scientific venture as consisting of long periods of normal science where the ruling paradigm is investigated. In this RC phase, almost everybody accepts the paradigm. However, once there are too many faults found in the paradigm a short-spanned revolution takes place. Thus the large group of scientists progress from the RC phase to an RI phase where scientists disagree with each other and there is a large amount of controversy. Then a new paradigm takes over, a phase transition occurs that leads to a new RC phase and scientists again agree.

Yet another example of a large group phase transition is Canetti's (1960) discharge. He writes:

The most important occurrence within the crowd is the discharge. Before this the crowd does not actually exist; it is the discharge which creates it. This is the moment when all who belong to the crowd get rid of their differences and feel equal. . . . An immense feeling of relief ensues. (p. 17-

18)

## Flows

Some parameters of a material phase can change while the phase remains the same. A liquid can flow from one place to another and the direction of a compass magnet can change. These processes have analogues among people (see Table 1). An example of a flow is the behavior of the town people in the story of Anna Elisabeth Rosmus (depicted in the movie The Nasty Girl), a woman who uncovers her home town's Nazi past. In the middle of her investigation, her town in southern Germany is united against her. The people avoid talking to her and most don't try to protect her from the harm she suffers. After a few years, she is sued by one of the subjects of her investigation. The court, however, is canceled because there are too many secrets that would come out if it were to go ahead. After this cancellation, the town people become supportive of her efforts. There was never a phase transition in which the town people started to act differently towards each other, for example, by going through an RI phase, only a collective change of heart. Most people started out against Anna, and then the group flowed to this new state (but not phase) where most people felt they were for her. Some people in the RC phase did not realize what had happened - they thought they had always been for her. What mattered to them was that they thought they agreed with the other town people around them. What they agreed about was of less importance. No intra-individual changes took place but the inter-individual collective behavior changed.

The fall of communism and the Berlin wall are similar examples of large group flow. People had turned into the RC phase and when change started to occur, they flowed in only a couple of years from a communist persuasion to a capitalist one. There was no revolution in the sense that everybody disagreed with each other, furthermore it seems that the communists in Russia still have the economic power. A fourth example are the perpetrators of the My Lai massacre (Kelman and Hamilton, 1989): they stopped their killing for lunch and invited two young vietnamese girls coming out of hiding to join them in eating (p. 9). Again no phase transition took place when this new bizarre behavior was adopted by the group. Finally, the flow of a group of people is nicely illustrated by non-revolutionary collective swings of

political and religious structure in France directly after the French Revolution (1790-1820). According to Le Bon (1895):

we see the crowd at first monarchical become very revolutionary, then very imperialistic, and again very monarchical. In the matter of religion it gravitates in the same lapse of time from Catholicism to atheism, then towards deism, and then returns to the most pronounced forms of Catholicism. . . . We observe with astonishment the prominent men of the Convention, the sworn enemies of kings, men who would have neither gods nor masters, become the humble servants of Napoleon, and afterwards, under Louis XVIII., piously carry candles in religious processions (p. 149-150).

## Tentative Model of Behavior in the Large Group

### Model Described

#### Model assumptions.

A necessary condition for fast, far-ranging inter-individual communication by oral language in the large group is that there exists an explicitly or implicitly agreed-upon topic to consider, a simplifying dimension (similar to the "emergence of a common object" or "emergent norm" see McPhail, 1991). Once chosen, this simplifying dimension (SD) allows information to be disseminated quickly and large group behavior can occur. The SD is consistent with the "violent affirmations" from Le Bon's (1985) observation that to rule a crowd, an "orator . . . must make an abusive use of violent affirmations. To exaggerate, to affirm, to resort to repetitions" (p. 34-35). These affirmations attempt to force a complex issue into a simplifying dimension.

#### The model.

One of the simplest physical systems with two phases and a phase transition is the Ising model (see Stanley, 1971). This model was originally applied to electron interactions caused by a property called their "spin," but can be easily translated from one model system to another. Let us translate this model into particular social terms: We consider a large group of people who communicate only with others close-by. For simplicity, the people are all standing on a regular rectangular grid and communicate only with the up-to-eight closest-by neighbors. Each person can say "yes" or "no" with regards to the simplifying dimension. There is also an authority present. There are two costs associated with having a particular opinion when interacting socially. First the cost of disagreement D that encourage people to conform to the opinions of their neighbors. Second, the cost of non-compliance N that encourage the people to obey the authority. Taking the perspective of the total group, the total cost C is:

$$C = D * (\text{number of neighboring people disagreeing}) + N * (\text{number of people not compliant with authority})$$

To include dynamics of the large group we need to allow for people to change their opinion. Thus our third and final parameter is the individual Temperature T. This parameter specifies the ease with which one changes one's stated opinion, the creativity, open-mindedness, risk-taking, or wishy-washiness that allows one to choose another answer.

In principle these parameters can be measured. For example, the ratio T/D (the ease with which to change one's opinion with a dissenting cost D) may be given by an Asch conformity experiment (Asch, 1956); and the ratio T/N (the ease with which to change one's opinion with cost of non-compliance N) by a Milgram obedience experiment (Milgram, 1975). Milgram's investigation of the influence of national character on the results of an Asch-type conformity experiment suggests that the ratio of T/D of French students is larger than of Norwegian students: The rates of conformity to the confederate peers in different situations were all higher for the Norwegian students than for the French students (Milgram, 1961).

Transition into Rigid Conformity

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INSERT FIGURE 1 ABOUT HERE  
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Let us consider the properties of this model without an authority (Fig. 1; the authority case will be covered later in the paper). If there is only one person in the group (Fig. 1 (a)), "Mary," she can change her mind with no external social cost. Once a second person is introduced (Fig. 1 (b)), keeping the opinion of the second fixed, Mary's disagreement now carries a cost of 2 D--one D from her disagreeing with the second person and another D from the second person then disagreeing with Mary. As more people join Mary (see Fig. 1 (c)-(e)), the total cost of disagreement continues to increase. Thus rigidity of Mary's opinion can develop. This situation is similar to the Asch experiment (Asch, 1956) where the subject is told of the opinions of the confederate subjects before being asked himself.

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INSERT FIGURE 2 ABOUT HERE

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But when a random large group gathers, there are not always single-minded Asch confederates present. For example, the individuals may start out with random opinions (Fig. 2). The total cost is about 342 D. This is easiest to see by counting the total number of close-by relationships and dividing by two (since by chance half of them would be disagreements). The RI phase is collectively stable, since once every person around is having a different opinion, it is hard to form a collective consensus (it is not individually stable--the cost to change one's opinion is small since one will offend about as many people as one will please).

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INSERT FIGURES 3 AND 4 ABOUT HERE

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After a while, people try to conform and it may happen that all will have the opinion of the unfilled circle or filled square (Fig. 3 or 4). The people have then entered the RC phase. The RC phase is collectively (and this time also individually ) stable since once it occurs it is very hard for any one person to change her or his mind and disagree with all close neighbors.

The phase transition from Fig. 2 to Fig. 3 (or to Fig. 4) in the large group will make the large group seem as if it is very different from before. An outsider will be faced with what looks like an overwhelmingly strong consensus with no room for disagreements. This is similar to the difference in the quality of water in the ice phase as compared to the liquid phase. But in physics, the water molecules are the same, whether in ice or in water. In the phase transition model of the large group, the people in the large group are also the same before and after the transition--it is only the group itself that seems different. This would negate Le Bon's view (1895) (criticized by, for example, McPhail, 1991) that the individual changes:

the most careful observations seem to prove that an individual immersed for some length of time in a crowd in action soon finds himself. . . in a special state, which much resembles the state of fascination in which the hypnotized individual finds himself in the hands of the hypnotiser (p. 11).

The impression of the existence of qualitatively different individuals in the state of nazi-Germany was similarly discounted by Arendt (1963) with her conception of Eichmann, executed for his role in the Holocaust, as a simple bureaucrat rather than evil impersonated.

### Effect of Parameters

Water freezes at exactly zero degrees Celsius and turns into water at exactly 100 degrees Celsius. In the physics of materials, phase transitions are shown to occur when relevant parameters pass through critical values. The Ising model has three relevant parameters: A transition from the RI to the RC phase (from the configuration in Fig. 2 to the configuration in Fig. 3) could have occurred when any of the three parameters D, N, and T reaches a critical value. We note that the "narrowness" is a property specific to phase transitions of large groups and how narrow the phase transition is depends upon how many constituents are present. Thus in physical materials we always see narrow transitions since they consist of about  $10^{23}$  atoms or molecules. The transitions of the large group will be less narrow and take place over a larger variation in the parameters D,N, and T. Note that the phase transition between RI and RC can occur both ways, but for simplicity we focus primarily on the RI to RC transition.

### D induced transition.

The transition into RC can be induced by D increasing to a critical high value. There are such variations in reality. In large groups, the interindividual interaction D can increase and become more important than intraindividual considerations (Le Bon, 1895). Dominance of D was often present in the Asch experiment (Asch, 1956) where people were shown to often conform to the obviously wrong

opinion of their peers (who were actually experimental confederates). Similarly, in the autokinetic effect, convergence of opinions occurred as to where a stationary object was illusionary moving (Sherif, 1961). As a large group is formed,  $D$  can increase as people get to know each other (in the terms of Tuckman (1965) the group goes from "storming" to "norming.")  $D$  would also increase if the large group gained a higher density and people were forced closer to each other or fear was instilled in the group (fear increases affiliation, see Schachter, 1959).

An effect of the  $D$  dependence is that the geometric arrangement of people can be very important in groups. If people are positioned in a circle and only communicate with their two neighbors, the phase model of the large group predicts that *this group will be less prone to transitioning into the RC phase*; no matter the size of the  $D$ 's, the temperature  $T$ , or the costs of non-compliance  $N$ . Think of sitting in a movie theater, for example, in the dark and telling your neighbor what you think of the movie. It should be somewhat easier than afterwards around a table in a coffee shop where you can hear and see what everybody else thinks, since if each person only communicates with a few people, the cost to disagree becomes smaller. In the physical model, there is no transition when there are too few possible  $D$ 's. Atoms and molecules will always move somewhat randomly and a minimum amount of rigidity (enough possible  $D$ 's) is necessary for this randomness to disappear.

#### $N$ induced transition.

An increase in  $N$ , by propaganda and media coverage, for example, can also lead to a transition into an RC phase. Authority causing a large  $N$  was central to Milgram's (1974) interpretation of his famous obedience experiments. He showed that people's individual decision making is highly influenced by the authority field they find themselves in. In the situation with the Teacher in the Milgram obedience experiment (p. 149), the tendency to obey becomes stronger the longer the experiment is carried on. Similarly the  $N$  increase leading to the RC phase is exemplified by the shift in science to a new paradigm after a period of controversy:  $N$  is the strength of the evidence emerging for the new paradigm.

### T induced transition.

A decrease in the temperature  $T$  (creativity, open-mindedness, risk-taking, or wishy-washiness) will also lead to an RC transition. This can occur in a variety of ways. For example, the daylight can decrease calming people, or a religious person can come and ask people to not fight and put their trust in God, or a rumor can spread that the effect of one's choice will not have much consequence so one might as well try to reach an agreement. As  $T$  reaches a critical low value the transition into RC sets in.

Let us revisit Kuhn's (1970) science example. In the first stage there is a ruling paradigm and an RC phase where most of the scientists agree (as in Fig. 3). Then there are defects found in the paradigm. Each contributes to making the scientists question the paradigm a little more and not only does  $N$  decrease,  $T$  can increase as well. Every defect can raise the temperature in the community for disagreements (Kuhn's "pronounced professional insecurity" (p. 67-68; or "blurring of a paradigm and the consequent loosening of the rules for normal research" (p. 84)). When there are too many defects present, a phase transition takes place into the RI phase. The new paradigm enters the large group which will now have randomly placed unfilled circles and filled squares (Fig. 2).

### The RC Phase and the Literature

Le Bon (1895) presents us with five observations of the behavior of some large groups that pertain to the RC phase (the RC phase is similar to what Le Bon calls the organized or psychological crowd (p. 2)): First, a crowd has a "collective mind which makes them [the individuals] feel, think, and act in a manner quite different from that in which each individual of them would feel, think, and act were he in a state of isolation" (p. 6). Indeed, Le Bon writes about crowds having collective hallucinations and gives examples thereof including mistaken identity of a dead body (even the "mother" was caught up in the hallucination!) and the mistaken identification of a stranded ship's crew (p. 23-29). An RC large group having undergone a phase transition from the RI phase, and therefore is different from the RI phase is

consistent with Le Bon's view of a "collective mind." This "collective mind" provides a situation in which the individuals respond differently but "are" not different.

Second, Le Bon notes the average of individual preferences does not become the preference of some large groups (p. 6). This particular phenomenon has been demonstrated in social psychology, see, for example, the autokinetic experiments (Sherif, 1961, and Johnson et al, 1977) in which the position of a stationary object proposed by the group deviates from the position averaged over individual opinions. Another similar example is the phenomenon of group-think (Janis, 1972). The RC phase is consistent with this averaging problem in that in some cases one opinion prevails over a whole large group (Figures 3 and 4) and the average of quasi-isolated individual preferences (as they start out in Fig. 2) no longer describes the group preference.

Once the phase transition into the RC phase has occurred in the large group, the initial individual forces are simplified (because of the SD) and, if they become the same, amplified. This is consistent with a third observation of Le Bon (1895): He writes that "whether the feelings exhibited by a crowd be good or bad, they present the double character of being very simple and very exaggerated" (p. 33). We can also say that an RC group of people can be less than the sum of its parts. From being a system of high entropy, the introduction of the SD and the ensuing RC makes for a system of little entropy and little information content. Le Bon (1895) writes "by the mere fact that he forms part of an organized crowd, a man descends several rungs in the ladder of civilization" (p. 12-14). Similarly Bion (1961) defines the word "group" as "an aggregation of individuals all in the same state of regression" (p. 142). This lowering of the information content of the large phase has its parallel in the lowering of the "heat" content of physical materials in their solid phases.

Phase transitions in physical systems first occur in small patches and then these patches coalesce. Close to the point of the global phase transition the size of the separately conforming patches increases. The phase transitions of the large group are usually limited to neighbors, cliques or clubs, but sometimes there are revolutions, during which a national consensus can be created. The physical phenomenon with

coalescence of conforming patches near a phase transition is similar to what Le Bon (1895) names contagion, a fourth characteristic of crowds (p. 10).

Fifth, the narrowness of a phase transition (see above) may account for some of the seeming impulsiveness of making up a crowd mind, as witnessed by Le Bon (1895, p. 16). Suddenly the patches of conforming behavior grow. This surprises the spectator which attributes it to suggestibility of the large group. The model also predicts that the larger the group, the more narrow and well defined the phases should be. Thus, the larger the group the more clearly one should discern Bion's (1961) basic assumption groups--emotional states of the group guarded by hostile responses to stimuli to development (p. 158-9).

Phase transitions can go both ways, in accordance with other observations of crowds. Canetti (1960) writes that the crowd "dies away as quickly as it has risen, and often as inexplicably; and it has, as goes without saying, its own restless and violent life" (p. 77). Similarly Freud (1921, p. 38) writes about the quick dissolution of the large group once the leader is gone.

The transition into RC resolves an apparent contradiction in the literature regarding the suggestibility of crowds: On the one hand, Le Bon (1895) observes that the crowd often is suggestible. He writes that "the idea which has entered the brain [of a crowd] tends to transform itself into an act. . . . All will depend on the nature of the exciting cause, and no longer, as in the case of the isolated individual, on the relations existing between the act suggested and the sum total of the reasons which may be urged against its realisation" (p. 21). On the other hand Couch (1968) writes "if crowds are as suggestible as some critics claim, they would pose no problem for authorities; all that would be necessary to disperse a crowd would be to suggest they break up and go for a cold swim. In fact, one of the distinctive features of a crowd is its lack of receptivity to suggestions offered by outside authorities." Similarly Berk (1974) argues that "the emphasis on the irrationality of crowd participants is at best misplaced." The contradiction is easily resolved within the framework of a phase transition. Before the phase transition takes place, there is a plurality of opinions; suddenly the opinions conform to only one. The path towards unanimity can be quick and irregular which gives an impression of suggestibility. Once the single opinion

is formed, a great RC phase results eliminating any signs of suggestibility and giving the authorities great trouble in controlling the crowd. Only if T increases, D or N decreases, or the new authority N field is very strong will the transition be reversed.

Splitting Boundaries

Just like it takes time for water to freeze or for ice to melt, time is needed to reach the RC phase of the large group (going from Fig. 2 to Fig. 3, for example). It turns out that if the process of changing the parameters D, N, and T, is too fast, the full consensus in the large group might not be reached. Instead the large group might end up in a phase that is not a perfectly homogenous RC phase but still seems to persist for a long time.

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INSERT FIGURE 5 ABOUT HERE  
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The simplest non-optimal configuration is the splitting boundary (See Fig. 5). Splitting boundaries (dashed line in Fig. 5) separate regions with unfilled circles and filled squares--part of the large group says yes, and the other part of the large group says no and the two are not intermingled. The splitting boundaries carry small costs if the number of possible D's is small, the N field is small, and if the boundary is reasonably straight (so that fewest possible unfavorable contacts across the boundary are made; in this particular example the cost is only 56 D). The cost of splitting boundaries in society is small: when groups polarize it is only the people at the boundary between the two groups that have to pay the cost of nonconformity.

Examples of phenomena with splitting boundaries are the U.S. abortion debate and the sharp differences in economic conditions and ethnicity across some neighborhoods in large U.S. cities. Communication mainly occurs within each group and not between the groups. Thus people in each group can conform to the majority opinion and only the people at the boundary have to suffer from costs from

dissent.

The splitting boundaries are somewhat hard to get rid of: Changing every person's opinion on one of the two sides in Fig. 5 is costly (up to 16 D per person). Thus the splitting boundaries are relatively stable. A painful way of eliminating social splitting boundaries is to start to increase the interactions across the boundaries. Besides being painful, it is also not clear what the outcome will be - both outcomes are equally possible! Increasing the interactions is similar to what was done with busing and what is the effect of the public abortion debate. According to this model there are better ways: changing the minds of people at the boundary costs at most 2-4 D's and this change can be done repeatedly (so that the boundary effectively moves to the right or left in Fig. 5). One could also take one of the communities and separately change the consensus in a continuous flow-like way and thereafter have the interactions increased across the boundary.

Dissent

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INSERT FIGURE 6 ABOUT HERE  
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In Fig. 6 is illustrated the cost of dissent. The cost is 80D, more than for the split situation of Fig. 5 (see also Table 2). This is in spite of having only six people who disagree in Fig. 6 versus forty in Fig. 5. Notice also, if the number of dissenters is small, they are easier to spot in the diagrams. Pinpointing the location of the filled squares in Fig. 6 is much easier than in Fig. 2. This is also true in reality if the expression of dissent, for example, is to be the only one stretching up an arm. This arm can be seen widely, not just close-by. Being easy to identify in the large group effectively increases the number of relationships (D's) possible and further increases the cost of dissent.

How to Make and Break a Dictatorship or a Violent Crowd

In light of the phase transition model - how could the most formidable consequence of obedience

and conformity - the dictatorship or the violent crowd be understood? First, how would such a strong consensus be created? This is done by increasing the number of connections between people (the number of possible D's in the model). One way is to scare everybody, for example by pointing out that another group is dangerous. (As shown by Schachter (1959), scared people tend to increase the affiliation.) Another way is to position people closely together or have them become more dependent upon each other. In addition to increasing D, T needs to be made small. This can be done by punishing disagreement, by limiting education and free speech or superficially calming people. Finally, N is increased, for example by a propaganda machine.

Notice that the D coupling is crucial, since even the strongest dictator or crowd leader cannot run the large group by her- or himself. In fact, the leader only gives a seed for the transformation: In our physics analogy a phase transition often starts with a small patch of molecules that have already transformed to the new phase. This seed enables the larger phase transformation to occur by properly ordering molecules at first near the transformed patch which then can grow (just like it is cheap to change people's mind at the boundary in Figure 5 but not inside the two respective subgroups). Indeed, Canetti (1960) writes that there are crowd crystals that have as only purpose to precipitate crowds. These are "small, rigid groups" of people "strictly delimited and of great constancy . . . [they] always appear the same" (p. 73). Milgram et al (1969) later calls the seed for a crowd the stimulus crowd.

How do we make the dictatorship or violent crowd disappear? The connections among people should be decreased and the temperature of the large group increased. The former can be done by better economic conditions, situations of low threat and more spacious housing. The latter can be done by increased education, and elimination of punishments for dissent and the introduction of free speech. One example in the literature is the "liberating effects" of the introduction of two dissenting confederates in the Milgram (1965) obedience experiment.

### Summary

The concepts of phases and phase transitions in the large group show why large group behavior can seem so qualitatively different at times, without insisting that the individual undergoes large changes. The model presented provides simple explanations for large group properties such as the abruptness in the making up of the mind of the large groups, the rigidity of large groups, the suggestibility of crowds and the prevalence of splitting phenomena.

The identification of three basic parameters, the cost to disagree  $D$  (and how this cost is distributed geometrically), the cost of non-compliance  $N$ , and the temperature  $T$  may provide a useful framework for the future study of large group behavior. The framework also seems useful to authorities (for example, to increase the temperature of a violent crowd to have it disperse) and grass roots (to defend against dictatorial tricks like crowd crystals) alike.

References

- ARENDDT, H. Eichmann in Jerusalem: A Report on the Banality of Evil. New York: Viking Press, 1963.
- ASCH, S.E. Studies of independence and conformity: a minority of one against a unanimous majority. Psychological Monographs, 1956, 70.
- BERK, R. A gaming approach to crowd behavior. American Sociological Review, 1974, 39, 355-373.
- BION, W. R. Experience in groups and other papers. New York: Tavistock Publications, 1961.
- CANETTI, E. Crowds and power. New York: The Continuum Publishing Corporation, orig. 1960, ed. 1993.
- COUCH, C. Collective behavior: an examination of some stereotypes. Social Problems, 1968, 15, 310-322.
- FREUD, S. Group psychology and the analysis of the ego, New York: W.W. Norton, orig. 1921, ed. 1989.
- HELBING, D. Boltzmann-like and Boltzmann-Fokker-Planck equations as a foundation of behavioral models, Physica A, , 1993, 196, 546-73.
- JANIS, I. Victims of groupthink: a psychological study of foreign-policy decisions and fiascoes. Boston: Houghton Mifflin, 1972.
- JOHNSON, N.R., STEMLER, J.G., HUNTER, D. Crowd behavior as risky shift: a laboratory experiment. Social Psychology Quarterly, 1977, 40, 183-187.
- KELMAN, H.C., HAMILTON, V.L. Crimes of obedience. New Haven: Yale University Press, 1989.
- KUHN, T. S. The structure of scientific revolutions, in the International Encyclopedia of Unified Science. Chicago: University of Chicago Press, 1970.
- LE BON, G. The crowd - a study of the popular mind. Atlanta: Cherokee Publishing Company,

orig. 1895, ed. 1982.

MCPHAIL, C. The Myth of the Madding Crowd. New York: Aldine de Gruyter, 1991.

MILGRAM, S. Nationality and conformity, Scientific American, 1961, 205, 45-51.

MILGRAM, S. Liberating effects of group pressure, J. Personality and Social Psychology, 1965, 1, 127-134.

MILGRAM, S.; BICKMAN, L.; BERKOWITZ, L. Note on the drawing power of crowds of different size. Journal of Personality & Social Psychology, 1969, 13, p. 79-82.

MILGRAM, S. Obedience to authority: an experimental View. New York: Harper and Row, 1974.

SCHACHTER, S. Psychology of affiliation. Stanford: Stanford University Press, 1959.

SHERIF, M. Conformity-Deviation, Norms, and Group Relations. In Conformity and deviation, ed. by I.A. Berg and B.M. Bass. Harper and Row, 1961.

STANLEY, H. Introduction to phase transitions and critical phenomena. Oxford: Clarendon Press, 1971.

TUCKMAN, B. Developmental sequences in small groups. Psychological Bulletin, 1965, 229-249.

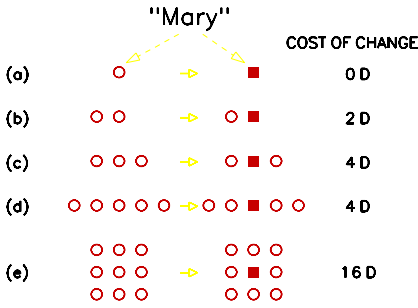
Tables

<u>Large group</u>	<u>Relatively Independent phase (RI)</u>	<u>Relatively conforming phase (RC)</u>	<u>Flow</u>
Crowd in square	Before speech	During speech	
Church goers	When not in church	When in church	
Army	Before commanded	While commanded	My Lai: first massacring, then inviting victims to lunch
Scientists	During scientific revolution	During ruling paradigm	
Anna Rosmus' town	When not thinking about Rosmus	When being defensive against Rosmus	First siding against Rosmus, then with her
Nations	Germany before nazism  Rwanda before mass killings	Germany during nazism  Rwanda during mass killings	France 1790-1820 (see text)  Fall of communism  Fall of Berlin wall
Lemmings	When not marching	When marching	
Birds	When not migrating	When migrating	

Table 1. Different large groups, their associated phases and non-phasic "flow" changes.

<u>Configuration</u>	<u>Cost (in units of D)</u>
RI phase (Fig. 2)	342
RC phase with a few dissenters (Fig. 6)	80
Split RC phase (Fig. 5)	56
RC phase (see Figs. 3 and 4)	0

Table 2. Costs of different states of the large group.



Figures

Figure 1. Symbolic representation of Mary with two opinions: the unfilled circle ("yes") and the filled square ("no"). The social cost for Mary changing opinions is indicated for situations of varying number of other people present: (a) There are no other people so the social cost is zero; (b) With one other person it costs two disagreements for Mary to change her mind (she disagrees with the other person and the other person disagrees with her); (c) with two other people the social cost is doubled--four disagreements; (d)

with four other people in a line the social cost is still four disagreements--in this model Mary does not see the two outermost people; (e) with eight close neighbors Mary has to pay sixteen D to change her mind.

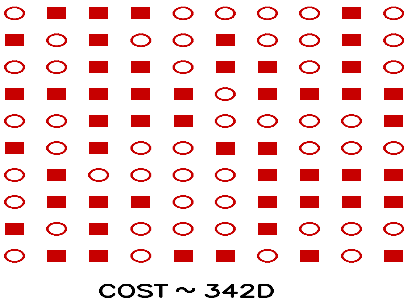


Figure 2. Symbolic representation of crowd suddenly gathered. The opinions are not yet influenced by the social field, and could be random. There are about 342 disagreements.

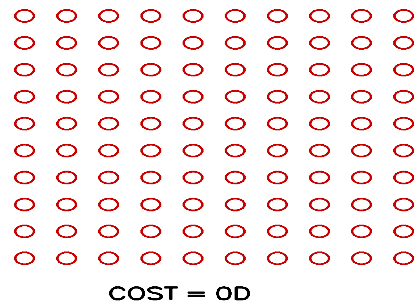


Figure 3. Symbolic representation of crowd in the unfilled circle RC phase, the yes phase. Here the social field completely determined the opinions and everybody conformed.

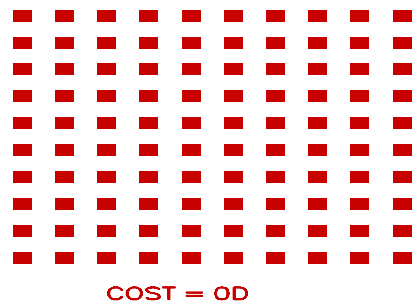


Figure 4. Symbolic representation of crowd in the filled square RC phase, the no phase. Again the social field determined the opinions and everybody conformed to the other possible opinion.

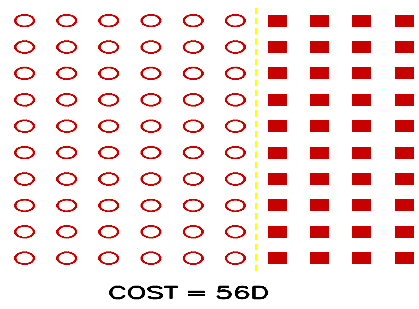


Figure 5. Symbolic representation of crowd in the RC phase with a splitting boundary.

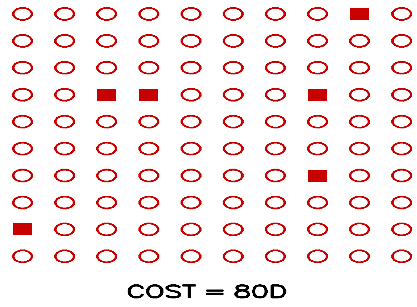


Figure 6. Symbolic representation of crowd in the RC phase with a few dissenters. Note that the social cost involved is larger than for the splitting boundary in Fig. 5.

Biographical Note

The author, Eugen Tarnow, is a management consultant with a degree in physics (Ph.D. 1989, M.I.T.). His interests include obedience rates, business vision statements, and the performance of large and small work groups including cockpit crews.

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