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## Synchrony and the Art of Signalling

*As soon as we are in the presence of other human beings, we align our behaviours with them. Though often unintentional, powerful social signals are produced when we synchronise our actions with each other.*

The 105<sup>th</sup> ‘Day of the Sun’ was marked by a military parade in North Korea in 2017. Thousands of soldiers, accompanied by several missiles, moved together in perfect synchrony to celebrate the birth of the state founder, Kim Il-sung. On that day they sent a message to the world, leaving no doubt that they are one and should be perceived as an inseparable entity representing their nation. Elsewhere on the continent, in the Mangrove trees along the riverbanks in Southeast Asia, similar displays of synchrony can be observed. When fireflies flash in perfect unison at a rate of about three times in two seconds, it looks as if stars in a pitch-dark sky appear and disappear in concert with each other.

Fireflies have attracted both nature lovers and scientists, though for a long time they were at a loss to explain the phenomenon. When Hugh M. Smith, an American biologist, reported the fireflies’ synchronous flashing in the 1930s for the first time, many scientists believed that it was an illusion, or mere coincidence (Sullivan, 1991). Today scientists think that the synchronous flashing is a signal related to mating behaviour. Male fireflies blink in unison to enhance their chances of attracting female fireflies (Moiseff & Copeland, 2010). The emergent synchrony between the insects can be explained with the help of mathematics. No leader or conductor is needed to coordinate the synchronous flashing, but fireflies self-organise themselves in synchrony like many other biological oscillating systems, such as cells that fire together to control our heartbeat, or crickets all chirping in perfect harmony (Strogatz, 2003).

The disco-light fireflies, blinking to attract a mate, seem to be a world apart from the North Korean soldiers, marching to inspire and intimidate. Yet, recent studies show

that these two types of behaviour are not just similar in their timing and coordination, they may each provide a very similar function, too.

### **From Fireflies to Human Beings**

As human beings we do not glow and usually do not chirp, but we do coordinate our behaviour in many other ways. Automatically and often unintentionally, we coordinate our postural sway (Shockley, D. C. Richardson, & Dale, 2009), walk in lockstep, align our speech patterns and eye gaze (D. C. Richardson, Dale, & Kirkham, 2007), imitate each other's facial expressions and mimic each other's movements (Chartrand & Bargh, 1999). As a psychological consequence we feel closer to each other and we form strong social bonds (Marsh, M. J. Richardson, & Schmidt, 2009). This happens not only when we coordinate without meaning to so, but also after we have engaged in effortful and intentional synchronous activities (Hove & Risen, 2009; Valdesolo, Ouyang, & DeSteno, 2010). Doing something – anything – together at the same time has important pro-social consequences.

Not only has synchronous behaviour, such as moving to the same beat or marching together, been found to increase liking between two people, but after engaging in an activity in synchrony people, for example, cooperate more with each other, they feel closer to each other and more similar, or they remember more information about each other. How are such far-reaching social consequences produced through synchronous behaviour? One way to explain the underlying mechanisms of interpersonal synchrony and how it affects us relates to our human ability to form shared representations of our social and physical environment and the neural processes that correlate with this.

Joint action, as any form of social interaction during which two or more individuals coordinate their action in space and time depends on the ability of interaction partners to share representations, predict actions, and to integrate the predicted effects of one's own, and the other's, actions (Sebanz, Bekkering, & Knoblich, 2006). In order to do this successfully, self- and other-related behaviour need to be effectively integrated, which happens at the neural level through the coupling of perception and action (Keller, Novembre, & Hove, 2014). In those cases in which the joint action is characterised by temporal coordination, by synchrony, an individual's brain is

required to simultaneously represent self- and other-generated actions and to integrate them in real time. With increasing coordination during social interaction, shared representations of a joint action are formed, which improve the ability to predict, anticipate, and adapt to another's movements (Keller et al., 2014; Konvalinka, Vuust, Roepstorff, & Frith, 2010). Thereby coordination can be realised with greater ease and a reduction in brain activity in areas related to cognitive control has been observed in the process (Fairhurst, Janata, & Keller, 2013). This reduction of activity in cognitive control areas coincided with an increase in brain activity in brain regions associated with socio-emotional processes, which may explain why synchronisation promotes pro-social thoughts and behaviour (Fairhurst et al., 2013). Synchrony seems to be characterised by a state of processing fluency, implying successful social interaction.

For a long time, researchers almost exclusively studied synchrony between pairs of people. In recent years, however, studies have also demonstrated that behavioural coordination between groups of people increases cohesion between them (Jackson et al., 2018), boosts liking and perceived social closeness (Tarr, Launay, Cohen, & Dunbar, 2015; Tarr, Launay, & Dunbar, 2014) and enhances cooperation (Reddish, Fischer, & Bulbulia, 2013).

In our lab, we also found that when a group experienced synchrony they were better at a joint task. We asked groups of around 20 students to chant in synchrony or to speak out of time with each other, and then asked them to play a video game together. They each had a handset that delivered a tiny nudge to a tightrope walker on screen. Collectively, they had to keep him balanced. We found that individuals not only reported higher levels of affiliation for their group when they had chanted together, but those groups were also better coordinated in the tightrope game (von Zimmermann & Richardson, 2016). As well as our objective measures of game performance, the experiment also gave us a peculiar subjective experience. It is rare that a psychology experiment has a spiritualistic vibe, yet that was our experience of being in a room with chanting participants.

The evidence shows that synchronous behaviour not only affects how we feel about one person, but also how we relate to a whole group. This is perhaps why large-scale

coordination can be observed in many aspects of social life, such as sports, dance, or music, and why it has been an essential and enduring part of human ritual.

### **The Costs and Benefits of Synchrony**

We feel attached to the people we know - those in our immediate social communities with whom we live, work and socialise. But we also often feel a strong connection with larger numbers of people, more people than we could possibly engage with in meaningful interaction. Human beings are prone to quickly develop shared social identities and research in the field of Social Identity Theory has shown that we often form and feel attached to groups in a heartbeat even when those are based on fairly arbitrary criteria, such as the preference for one painting over another (Tajfel & Turner, 1986). Researchers have recently argued that synchrony could be an adaptive mechanism to maintain larger social networks, to feel connected to whole communities rather than just individuals, and to increase group cohesion (Launay, Tarr, & Dunbar, 2016).

From a cognitive perspective, it has been claimed that the amount of social contacts we can realistically sustain is limited to about 150 (Dunbar, 1992). This is about the size of villages and human groups through much of human history, and today approximately corresponds to the median number of Facebook friends. Other primates, in comparison, can only pick fleas of one person at a time, which means that creating social bonds is time-consuming and restricted in scope. But human beings do feel a sense of connection with groups much larger in numbers than they could sustain through grooming. Launay and colleagues argue that through dance and music, rituals and sports, bonding can take place between multiple individuals simultaneously and studies have shown that moving together in unison releases endorphins (Tarr et al., 2015; Tarr, Launay, & Dunbar, 2016), and activates the brain's reward system (Kokal, Engel, Kirschner, & Keysers, 2011). These physiological processes potentially help to reinforce large-scale, rhythmical human movement. Instead of only ever grooming individuals directly and establishing close social contacts, we may have developed mechanisms that allow us to bond with high numbers of people and to maintain these bonds over time. Mass coordination becomes the 'social glue' through which social communities were and still are sustained and strengthened.

If this is so, one important question about human rituals can be answered. All human societies that we know about have always danced and made music together and human rituals often involve complicated coordinated movement and speech. The latter are difficult to achieve and require a lot of energy and training and could therefore be regarded as costly behaviour. The time and energy needed to dance and make music together could even be considered a luxury. However, if joint activities that involve coordinated behaviour really have the important function of establishing and maintaining meaningful social bonds between people, as Launay and colleagues suggest, then, all of a sudden, the benefits of coordinated behaviour possibly outweigh its costs.

### **Marching Together and Feeling Together**

Military parades are some of the most dramatic and fascinating displays of human synchrony. When thousands of soldiers march together in unison, indistinguishable from each other, we pause in awe and admiration. To this day, drill is part of a rigorous training regimen for soldiers all over the world. And yet, since the invention of the cannon and the machine gun, lining up in ordered rows and walking slowly towards the enemy is largely recognised as a poor stratagem.

Why are soldiers still required to march together today, when ‘a more useless exercise would be hard to imagine’, to quote the historian William H. McNeill? One possible explanation is that marching together creates obedience to a relevant authority, a behavioural mode that is certainly considered critical in the military. One of Wiltermuth’s experiments from 2012 supports this assumption. He asked participants to walk around campus a few steps behind an experimenter. In one condition, they were told just to follow him, while in another they were told to match his footsteps, walking in time with him. Then the experimenter requested that they help out with a different experiment that involved placing as many sow bugs into an ‘extermination machine’ as they could in 30 seconds. Of course, no sow bugs were ever killed during these experiments, but the participants themselves did not know this. The researchers found that those participants who had previously marched in synchrony with the experimenter sent approximately 54% more bugs to their death than the participants who had walked at their own rate.

In his book *Keeping together in Time: Dance and Drill in Human History*, McNeill (1995) offers a less chilling answer to his own question. Similar to Launay and colleagues (2016) he proposes that synchronous activities have an important social function and that rhythmically moving together in unison leads to ‘muscular bonding’ and alters human feelings to create enhanced group solidarity and cohesion. However, especially when it comes to drill, the creation of strong bonds between group members is probably not the sole purpose and effect of movement in unison. Displaying synchronous behaviour does not only have pro-social consequences for actors, but synchronicity also functions as a signal to observers.

During the military parade in North Korea in 2017, the soldiers who marched in perfect unison signalled to outsiders that they are highly disciplined and committed to a larger goal. The display of highly skilled synchronisation awes the viewer, because it is apparent that only through mentally and physically costly, time-consuming training and devotion the group could have achieved such accuracy in unified collective behaviour. To watching friends and foes alike, this signals dedication and within group cohesion, but also strength and potency.

### **Coalition Signalling**

Hagen and Bryant (2003) claim that music and dance have, at least in part, always served as a ‘coalition signalling system’. If a group wants to attract new members and form new alliances, or deter an enemy, the quality of the group or coalition needs to be assessable. While the size of the group may be an important attribute that hints at its level of appeal, there are two other important features, which can provide information about the quality of a coalition: The first one is the motivation of the group to act collectively to achieve a common goal, which can be derived from the internal stability or the levels of cohesion amongst the group members. The second feature of coalition quality is the ability of group members to act together. All parties have an interest that information on coalition quality is communicated quickly and groups need to adopt strategies to signal and detect it at the same time.

According to Hagen and Bryant, music and dance may be particularly useful signals, because they have two important universal features, synchrony and variation, which both require time and practice if they are to be carried out in a complex and

sophisticated manner. This means that only long-established and well-functioning coalitions are able to perform complex music and dance pieces, signalling high levels of cohesion and capability to other groups. Displays of coordination skills can be used to demonstrate strength, frighten another group and discourage them from attack, but they can also be used to demonstrate collective interest and the intent to form an alliance and to cooperate. The ritualistic Maori dance, the *haka*, is the perfect example of this dual function. While the *haka* is traditionally referred to as a war dance, it is also frequently practiced to greet important visitors and to honour exceptional individuals or groups of people.

### **The Dual Function of Synchrony**

The signalling function of group synchrony to outsiders has received less experimental attention than its pro-social effects within the group. This is surprising given that military parades, such as the one in North Korea last year, clearly not only constitute a self-affirmative display of internal cohesion, skill and power, but they also send a clear message of strength and ability to any group considering to attack. In order to preserve themselves, social groups always have to engage in two social processes at the same time. They need to maintain ingroup cohesion and they also need to translate their internal cohesion into an external signal that depending on the social context either attracts new members and even whole groups or that deters enemies.

Research has shown that perceivers have intuitive theories about the type of group they are confronted with and the relational properties of the group (Lickel, Hamilton, & Sherman, 2001). The entitativity, essentialism, or ‘groupness’ of a group, referring to the extent to which a group is perceived as a coherent and an agentic unit, has been identified as a particularly prevalent concept, which human beings use to form intuitive judgments about social groups (Kashima et al., 2005; Lickel et al., 2000). From the synchrony literature we know that observers, asked to rate interacting individuals in terms of their social closeness, report that they perceive those who are in synchrony with each other as one entity and as having stronger social bonds than those who are not synchronised. One study even showed that human beings draw inferences about the cohesion and strength of coalitions from synchronous behaviour (Fessler & Holbrook, 2016). In their study, the researchers tested how participants

would estimate the fighting capacity of either soldiers or terrorists in relation to the observed synchronicity of their footsteps. They found that participants rated synchronised targets as more muscular and larger. Synchronous behaviour seems to have a dual function. It does not only create and maintain cohesion within groups, but it also sends a compelling social signal to those who observe it.

### **Synchrony as a Social Signal**

Fireflies are not the only creatures that send a powerful signal to others through a display of synchronisation. Human beings do the same. Through the deliberate and skillful coordination of activities, social groups signal to observers that they are a functional and potent social entity characterised by high levels of cohesion. They demonstrate that they have unequivocally internalised a shared social identity. Soldiers marching in synchrony, convincingly and impressively demonstrating their unity, are likely to feel closer to each other and to form strong social bonds, but they will also send a powerful signal to either attract present and future members of the group or to deter opponents.

To this date, research has mostly focused on the social effects of synchrony, the mechanisms that may cause them, and the emphasis has been on the actors who engage in it. Many questions remain unanswered, however, about the role of observers and the signalling power of group synchrony, especially in relation to politics. Does a display of large-scale synchronous activities primarily cause feelings of awe and admiration or does it signal potency, intimidation, and animosity? Which role does the social context play in which military parades, for example, are perceived and by whom? In times of political instability and uneasiness, it is ever more important to empirically test if synchronicity in groups indeed carries important social and political messages and how these are received and under which circumstances.

The political topicality of this topic is hard to miss. Donald Trump has announced his intentions to hold the first military parade since the end of the Gulf War in 1991 this year with costs estimated at up to \$50 million dollars. His parade to display military power seems like a dangerous idea to critics, who draw attention to threats of war and oppose to any attempts of aggressively demonstrating and trying to reinforce America's waning global hegemony. Trump on the other hand believes that a military



parade would be great for his country's spirit. It seems likely that both sides are right. While a military parade would send a message of dominance to adversaries, it may simultaneously inspire the nation, boost its self-esteem, and increase feelings of solidarity, connectedness and national identity.

We should not underestimate the effect that the synchronous behaviour can have, for actors and observers alike. It can bond groups together, but also turn them against outsiders. It can increase their affiliation and performance, but also make them more compliant and obedient. Our bodies are powerful instruments in any social context and we sometimes unintentionally and sometimes intentionally align our behaviours with those around us. This affects us as individuals while at the same time we are affecting others. Synchrony is a powerful social signal.

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