

STUDI

How is freedom of the will “neurally” and mentally possible

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Abstract In this paper a solution to the problem of freedom of the will is proposed which treats it not as antithetical to determinism, but as admitting of degrees that run parallel to the degrees of control we exercise over thought, movement and action. We begin by examining the viability of Benjamin Libet’s solution to the problem of the freedom of the will, as consisting in vetoing-and-halting an action already originated in the brain. We are arguing that this solution is possible if refraining acts (intentional “not-doing”) can be considered not only as different kinds of actions from performing acts (“doing”), but also as peculiar actions that have causal consequences without having a result component. Such a commitment to an odd model of action makes plausible Daniel Wegner’s interpretation of Libet’s experimental findings as supporting the idea that freedom of the will is to be explained away as an illusion. We argue instead that voluntary actions are ones in which variable to maximal controls are exercised, and this is a learned set of procedures enhanced by experience towards better control and more freedom.

KEYWORDS: Free Will; Consciousness; Determinism; Naturalism; Cognitive Science

Riassunto *La possibilità “neurale” e mentale della libertà del volere* – Nel presente lavoro si avanza una soluzione al problema del libero arbitrio che non si pone in termini antitetici al determinismo, considerando piuttosto una soluzione per gradi, paralleli ai gradi di controllo che esercitiamo sul pensiero, sul movimento e sull’azione. Dapprima si valuterà la sostenibilità della soluzione di Benjamin Libet al problema del libero arbitrio, intesa come possibilità di veto e di arresto di un’azione che ha già avuto origine a livello cerebrale. Si sosterrà la possibilità di questa soluzione, se gli atti di astensione (il “non-fare” intenzionale) possono essere considerati non solo come tipi di azioni diversi dagli atti di esecuzione (il “fare”), ma anche come azioni peculiari che hanno conseguenze causali senza possedere una componente di risultato. Tale sostegno a un insolito modello di azione rende plausibile l’interpretazione dei risultati sperimentali di Libet avanzata da Daniel Wegner a supporto dell’idea per cui il libero arbitrio debba essere spiegato come un’illusione. Di contro noi sosterremo che le azioni volontarie sono quelle in cui si esercita un controllo variabile da un minimo a un massimo e che tali gradi di controllo costituiscono un insieme di procedure apprese, potenziate dall’esperienza e dirette verso un sempre migliore controllo e una maggiore libertà.

PAROLE CHIAVE: Libertà del volere; Coscienza; Determinismo; Naturalismo; Scienza cognitiva

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1 Free vs Determined Will: Theoretical and practical peculiarities

GIVEN THAT OUR PERENNIAL CONCERN has mostly to do with the behavior of humans, it is understandable that the problem of the free vs. determined will is the most ancient of philosophical riddles which can be understood by any mature human being without previous philosophical training. At the same time, however, it is a problem in which the traditionally proposed solutions seem to have no practical impact. Even if one were to adopt a strictly deterministic position which considers human behavior to be every bit as determined as the behavior of animals, this would not lead to the practical conclusion that we ought to banish lawcourts or prisons or alter in the least any of our commonly accepted practices. Choices will continue to be made, responsibilities to be assigned or admitted, and punishments to be imposed, while serious doubts will continue to be raised as to the contribution of punishment to prevention or correction, with retribution as the main reason for increase or moderation of punishment.

We maintain that the problem of the freedom of the will in a world determined by an ubiquitous causality principle has been solved, and though the solution is more complicated than the traditional alternatives (libertarianism, hard determinism, soft determinism) would have us believe, we will attempt to sketch out and defend this solution and summarize its basic tenets at the end. However, in spite of the correctness of our position, we do not expect that even if it were to be accepted as the final correct solution, it would stop humans from posing it as a problem that raises philosophical doubts, because it concerns us as a daily practical matter, rather than as a theoretical difficulty in philosophy. This peculiarity of the free will problem is no indication that philosophical problems have no consequences in everyday life, but an indication of a serious aspect at the heart of the problem. We are accustomed to thinking that either our will is always determined or it is at times free. We will argue that what we are faced with is not just a theoretical dichotomy between free vs determined will.

To begin with, it is not an exclusive disjunction because the will is in many cases of behavior and on many levels both free and determined, and the contribution of either factor cannot be considered as fixed as it varies in uncountable degrees and directions. More importantly, the dichotomy extends beyond belief to an “ambivalence” in sentiment. We have no idea what an absolutely free will is or an absolutely determined will could be, and I suspect we would not like to have either. Instead we want will to be both free and determined in different combinations in differing circumstances, differently in us or in others, differently in people close to us or dis-

tant to us, and even to ourselves in different periods of our lives for which we do rightfully wonder “I do not know what possessed me then and I acted in the way I did”. We want our will to be both free and determined and, in this paper, we will attempt to show how this is possible.

Stated in general terms, the traditional problem consists in the difficulty of finding a way of compromising the causal determinism that is postulated, followed and vindicated in our attempt to know the world, with our experientially entrenched belief that human actions, for which responsibility is assigned, are a result of reasons (not just causes), and could have not happened or have happened differently, had the agent in question thought or decided differently. The problem is transformed and intensified historically with the progress of the sciences, as they propose new models of causal determination (or even exceptions to causal determination).

We are not referring here only to determinism inherent in the physical sciences where causality reigns supreme both in doctrine and method (since “in experimenting we use causes in order to find causes”), but also in the sciences concerning humans, where models of strict causal determination are proposed, as for example in Freud’s theory of how the unconscious affects choices and decisions, or Skinner’s explanation of all learned behavior as determined by past reinforcement, and even more global schemata, like those employed in the dialectical materialism proposed by Marx and Engels. In general, it is difficult to do any science, if you have no causal determination to postulate.

2 Defending Free Will from neural determinism

There is hardly any doubt that human behavior is determined in many ways, by physical, chemical, biological factors, by evolution, heredity, environment, personality, education, but also by social, political, economic and historical conditions. All these determining factors upon which we depend on for successful practices and interactions do not preclude the possibility of free will, while in some way they have to presuppose the existence and mediation of a strong kind of determining neural factor.

We have no idea how the aforementioned many interacting factors (together with what the organism has encountered, suffered and somehow remembers in the trajectory it marks in the world), affect the organism exactly, but we cannot imagine any influence that does not involve changes and restructuring of neural connections.¹ This neural factor generates the idea of a strong determinism implying the causal determination of all human behavior, and specifically voluntary actions, by preceding neural events. It is against this kind

of determinism that the possibility of “freedom of the will” must be established, if it could ever be. There are thus two possible outcomes: either freedom of the will is “neurally” possible (LIBET 2004), or it is to be explained away as an illusion (WEGNER 2002).

Freedom of the will is an experienced “fact”² defined as a peculiar kind of causation. We have no problem seeing much of what happens inside human and animal bodies as absolutely determined and regulated by neural function, and even much of human and animal behavior as caused or regulated by neural events. In the case of voluntary acts, however, we have the opposite fact at hand. The actions so described are ones in which, if not deliberation and conscious decision, in every case at least some minimal anticipation of results has taken place prior to the action, which contributed to cause the action. It is part of the accepted common lore that an action is free, if it could have been otherwise, had we known or deliberated differently or decided otherwise.

There is no doubt that there are deliberate acts. Criminal courts take pains and often succeed in establishing premeditation beyond reasonable doubt. But even in a “perfect or not-so-perfect” crime, or generally in any planned action contemplated long before and meticulously set up, there are at least two points where neural determinism enters. In the first place, all the preceding deliberation of which the subject is, or becomes conscious does not happen in a causal vacuum but first and foremost in the brain.³ In the second place, even the longest and most meticulous deliberation is not an action, unless a decision that gets the action going, first “neurally” and then “muscularly” (including the muscles of the speaking tongue), is originated “consciously” by the agent. What does neuroscience have to say about these two neural underpinnings of willful action?

3 Neural determinism resting on the experimental findings of B. Libet

The experiments of Benjamin Libet have established two results pertaining to the two points where neural determinism affects human action. In the first place concerning deliberation, as well as any kind of consciously experienced neural event, Libet has shown (and further studies have confirmed) that consciousness temporally follows neural activation by a famous gap of about half a second. The task of monitoring self and reality, normally assigned to consciousness, is thus shown to be lagging brain activity by 500 msec, yet a monitor that is half a second late is still a very good monitor.

As for our well-known capacity to take stock of reality and react immediately in response, Libet proposes an explanation in the “subjective antedating” of events which gives the illusion of immediate

response. The well-known example of the driver who sees a child running onto the street and steps on the car break is explained by Libet’s suggestion that the breaking act itself happened automatically, just before the driver was consciously aware of the child’s running onto the street, and this late conscious awareness was “antedated” by 500 msec to become synchronous with (or even slightly previous to) the breaking act itself. The proposed explanation was tested in yet another confirming experiment (LIBET *et alii* 1979).

Concerning the decision that gets an action going, Libet examines the simplest kind of voluntary (in the sense of “consciously decided”) act, that of moving one’s hand, and asks of his subjects to remember the exact time when they consciously experienced the decision to move the hand on an observed timing device placed in front of them, while EEG electrodes on their scalp measure readiness potentials for this decision and the subsequent motion. The results of this experiment were consistent with the previous ones, indicating a time lapse of 350 msec between the origination of the surge in the readiness potential (indicated in the EEG) and the awareness of the decision to move one’s hand (as reported by the subject). Actual movement of the hand comes 150 msec later as shown in the EMG (*ElectroMusculoGraph*). If this picture is correct, then the decision to move the hand originates in the brain, unbeknownst to the subject, half a second before the actual hand motion. The agent consciously experiences the decision after 350 msec and just 150 msec prior to the act itself, and thus he or she naturally attributes the act causally to the consciously felt decision (LIBET *et alii* 1983, 1985).

Shocking as these results might be to common sense, by ideology raised as an unquestioning responsible libertarian, they should have come as no surprise to any thinker open to physicalism. Though we have no agreement on a definition of consciousness yet, still it is widely accepted that it is a biological process and a “higher” process at that. Its requirements are high in both energy and “head start” needed.⁴ So for consciousness of a decision to arise “in the mind”, the brain must certainly work “overtime” beforehand. Why would we be surprised if we agree that for every mental event, some prior activation of parts of the brain is required. Could it be otherwise? At this point one may be tempted to accept Wegner’s (2002) stand concerning the illusion of conscious will as vindicated by Libet’s results.

Wegner’s well-known model indicates that a common neural event causes both the action and the consciousness of the decision just a moment before the action. If this is so, we were bound to fall for that *post hoc, ergo propter hoc* fallacy, as we are bound to fall for other illusions like the Müller-Lyer or the moon illusion. Wegner’s position is

further reinforced by experiments of Alvaro Pascual-Leone and colleagues (cf., i.a., 1999, 2000) in which the subject’s decision to choose to move either the left or the right hand (monitored by the detection of readiness activity in the right or the left motor cortex correspondingly) is reversed by the experimenter’s intervention, who by using TMS (*Transcranial Magnetic Stimulation*) causes the action opposite to the one initially chosen (as revealed by the readiness potential).

The important find here is that the subjects do not report experiencing any kind of coercion (of the type “I wanted to move my right hand, but somehow I could not”), but experience the thwarting of the initial decision and fulfillment of the opposite alternative as a simple “change of mind”, while we know that it was exclusively due to the experimenter’s technical intervention. One could take Wegner’s theory as the default position and consider it as well-justified because it provides a general explanation for voluntary acts and some related phenomena (like hypnotism). Libet’s findings concerning subjective antedating make Wegner’s position stronger. As matters stand, the only way out of the Wegner default position is Libet’s argument that there has to be a good evolutionary ground for the 150 msec gap between consciousness of a decision to act and the act itself. If we are neural puppets, why, unlike zombies, do we feel? Or even, why do we not feel “like puppets”?

4 Libet’s conjecture: Freedom as refraining from completing an action

Libet’s well known conjecture is that the evolutionary basis for the 150msec between consciousness of the wish to move and the actual muscular start of the movement rests on the possibility of “vetoing”, or, in any case, consciously halting or not allowing, the act about to happen. In this way, consciousness becomes a determinant of voluntary action beyond its neural origins, albeit in a negative way: it allows or inhibits the action originated 350msecs earlier in the brain.

Aptly nicknamed “freedom of the won’t”, as opposed to the canonical “freedom of the will”, Libet’s conjecture deserves our full attention as a “last ditch” attempt to introduce an element of effective consciousness in the explanation of behavior. Put in another way, it is not freedom to do, but freedom not to do what was already initiated by the brain 350 msec earlier.⁵ By the same token however, if we are in a position to consciously stop an action from happening, then in effect we have responsibility for the ones we allowed to happen, since we could have stopped them (and didn’t).

Our initial question then becomes: is the above a viable position in support of limited freedom of the will, conceived traditionally, or is it a “last ditch

cop out” to salvage free will on the face of the incontrovertible neurological finds?

The immediate counterargument to Libet’s proposal is that if freedom of the will consists in the possibility of not doing what the brain has beforehand (350msecs) originated in the 150 msec between the consciousness of the decision and the action itself, then this refraining-from-doing has the status of an agent’s action, since the agent is considered legally responsible and accountable for it. But if it is an action of the agent, albeit a negative one, then, according to Libet’s experimental findings, it should be originated in the brain about 500 msec before its occurrence. This would lead to the following absurd result: For an action in which freedom of the will was exercised and the initiated action vetoed, it is necessary that the brain initiated first the refraining and then the action which the refraining would halt.

This is absurd on many counts. In the first place, the conscious wish to refrain from an act would come before the conscious wish to the act itself! In addition, it would make the brain not only prophetic but also rather silly: what would be the point of originating a refraining and then starting the action that would be refrained from anyway?

In the second place, if refraining from acting is itself an action, and a free one at that, then it should itself allow for refraining (“refraining-from-the-refraining”), which would lead to the absurdity of an infinite regress of a Zenonian or Kafkaesque type. This second argument holds even if we make an exception for refraining and assign their temporal origin as synchronous to the surge of the readiness potential for the original action. On the other hand, if freedom is to have any significance, then the same reasoning applies to non-refraining as well, so all actions, whether carried out or not carried out, must be preceded or accompanied by another event allowing them to happen or not, which neurally precedes or co-occurs with their origination. But in this case the origination of the action in the brain has two possible outcomes which diverge: one leads to halting the other to allowing the action to be completed. Selection between the two outcomes cannot happen before the start of the act for the reasons we presented above. But if to allow an action to happen is identical to the action itself, then the action is possible, but since it is the only action that is possible, this precludes any freedom of the will, for which we agreed that it characterizes actions which could have not happened (had we deliberated differently or decided otherwise). But the same reasoning applies to the refraining outcome as well.

These arguments rest on the assumption that refrainings are kinds of actions. The viability of Libet’s solution has to be pursued in the direction of examining whether refrainings, which are inten-

tional “not doings”, are actions that are similar to the positive actions (“performings”) for which the prior origination in the brain is needed. There are two philosophical schools of thought on this matter.

The best-known representative of the negative position is Georg Henrik von Wright (1963) who considered refrainings as essentially different from positive doings (or “performings”), since refrainings require a different kind of analysis that makes mention of what could have been done, but was not, i.e. a counterfactual conditional. Arthur Danto (1973) and Myles Brand (1971) took another line arguing that refrainings are just like any other mediated act (and most actions are mediated), since in refrainings you do one action in order not to do another. So, the guard refrains from shooting the fugitive by taking his finger away from the trigger, while in the performing occasion he shoots the fugitive by squeezing the trigger. The advantage of this position is simplicity: we need only one model of action to handle both performings and refrainings, while the other approach needs two, with the second kind involving counterfactuals. Still, as we have shown earlier, to consider refrainings as some kinds of mediated actions would lead to absurdities when we take into account Libet’s finding in neurophysiology. The position of Danto and Brand on refrainings has to be abandoned.⁶

5 Wittgenstein and McCann on mediated and unmediated acts

The other conclusion along the way is that for Libet’s position to be viable we have to consider refrainings as different from performings, so that the former can act as a kind of brake for the latter.⁷ But what kind of action could a refraining be, if we are to be responsible for it, while it cannot happen in the normal way that any performing is carried out?

The rejection of the Danto-Brand position showed one important characteristic of such an action. It cannot be “mediated” by another action, positive or negative, because that would lead to the absurdities we indicated. So it has to be an “immediate” (or “unmediated”) type of action. To pursue this line of thought, we return to Ludwig Wittgenstein’s original subtraction problem which started the whole theory of action:

what is left over if I subtract the fact that my hand goes up from the fact that I raise my hand (*Philosophical investigations*, §621).

It is obvious that since actions bring about changes in the world, this problem amounts to determining the difference between actions and other events, like bodily movements that affect changes. It is searching after the effective volition,

or the elusive intention that presumably characterizes actions.

One of the fundamental laws that was postulated in that part of analytic philosophy is the *Action-Result Law*, which states that: an action *A* always implies its event component *a*, but not vice versa. For example, by the *A-R Law* “I am raising my arm” implies “my arm is raised”, but “my arm is raised” does not imply “I am raising my arm”.

Let us note two ontological difficulties that refraining must face: their event component is not a real event, but a negative event! Here lurks a long-forgotten dispute over “negative facts” which blocked any simple-minded correspondence theory of truth, in favor of semantic ones (since the times of Aristotle’s *On interpretation*). A second difficulty however still awaits us, because refraining may violate the *A-R Law*: the *refraining-from-doing-A* does not imply *not a* (a-did-not-happen), because it is possible for it to have happened in spite of the refraining, as in the case where the guard refrains from shooting the fugitive by aiming high in the air and the bullet ends up hitting the fugitive,⁸ or even if another guard shoots the fugitive.

This alternative is not open for performing which necessarily implies the result. Clearly performing and refraining are not symmetrical, which advocates in favor of von Wright’s position that the counterfactually stated intentionality has to be part of refraining.

Using the *A-R Law*, Hugh McCann (1974), develops a logically equivalent form of Wittgenstein’s subtraction problem: “What must be added to an event to make it the result of an action?”. For example: what must be added to event *a* (Smith’s death) to make it the result of an action *A* (the murder of Smith). The proposed answer is that we need to add another action *B* (the shooting of Smith) which is causally more basic than *A*, in the sense that *B* is the actual “mediator” (of the many possible “mediators”) of *A*, which has *a not as a result but as a causal consequence*. But then *B* in turn has as a result *b* (Smith’s being shot), and the same problem can be regenerated *ad infinitum* (gun aimed, gun fired, trigger squeezed, finger pulled, muscles contracted, neurons activated, synapses firing, and so on) unless we can find some basic action *Z* which has causal consequences but does not have a result component *z*.

Mc Cann expects that such “actions” could be the elusive volitions which, as mental acts, do not have result components but “somehow” have causal consequences that get the rest of the mediated action going (or not going, if Libet’s conjecture is right). If Mc Cann’s position has any plausibility, could we consider refrainings as involving volitions which have causal consequences without having action components? Or are we only facing an after-the-fact fictitious claim “I could have done this act, but I refrained from doing it”, a

claim that can be made for any action that remained undone.

6 Teleology and intentionality naturalized by the cognitive revolution

Anyone versed in *Aristotelian Cosmology* or *Scholastic Theology* would see in this idea a version of the cosmological argument aiming to prove the existence of an *Unmoved Mover* setting and keeping the universe in motion. If one accepts that nothing moves unless it is moved by some other previous motion and also accepts that there is motion at present, then this would lead to an infinite regress of movers and moved, unless we find something that can cause motion without itself being in motion.⁹ But even if one admits the intellectual need for an unmoved mover, still the question “how can a mover move while remaining unmoved or unmoving” remains.

In the same way to say that a refraining is in fact a mental act (or a volition) that “somehow” stops an action from happening, is not to be accepted as a viable solution, unless that “somehow” is adequately spelled out. Any attempt in that direction would easily send us back to the old problem of psychophysical causation of how a thought can (which is a symbolic representation subject to the laws of logic, semantics, and association) produce an action (which is a physical movement subject to the laws of mechanics and biology).

The “queer yet fanciful” solution that Aristotle proposes to the problem of how a mover could move something without moving, offers an interesting suggestion, which in some way affects the Libet findings, and bargains on the two ways in which causal mediation can be analyzed, as we shall explain later. *Aristotle’s Prime Mover*, who in *Physics* appears as a moving (efficient) cause that “pushed” from the past to the present, in *Metaphysics* it (He?) becomes a final cause that leads the present towards a later stage. The example of “unmoving cause of motion” Aristotle gives is that of the object of love, which without moving causes the prospective lover to go through a whole lot of motions.

Of course, the exact way in which the sphere of heavens (*primum mobile*) is pursuing God (or God’s mind) and thus is caused to move by something that does not move, is better left to the imagination of Dante who in the concluding stanza of the *Divine Comedy* believes he had a furtive glimpse of “the Love that moves the world and all the stars” Modern sensitivities would shy away from this metaphor as reminiscent of “blaming the rape victim for the rape”.¹⁰ Moreover, we have rightfully abandoned teleonomy since the times of Newton, Laplace, and Darwin, but have we expunged it from all corners of science?

Certainly, classical mechanics and whatever rests on it are happy without teleology. In a similar

vein, biology, which was an area where teleology and entelechy were thought as reigning supreme,¹¹ was better served when it abandoned such teleological thought, for its biochemical-cum-evolutionary equivalent. The latter could explain the details of the structure, as well as fossil evidence, and, above all, intellectually speaking, it avoids the scandalous putting of the cause temporarily after the effect. To use Israel Scheffler’s (1962) example, if the final cause of the lungs is breathing, then how do we explain that, both ontogenetically and phylogenetically, lungs appear first and breathing follows. Avoiding the violation of the temporal priority of cause over effect was the main advantage of behaviorist explanations in terms of previous reinforcement. These were finally replaced when cognitivism placed the scope and aims of behavior in their proper temporal order as representations of desires, beliefs and decisions occurring prior to the occurrence of behavior. In this way cognitivism “naturalizes” intentionality. But at what cost?

Still however some nagging sense of the end-condition guiding the present condition survives even in the physical sciences. Perhaps the mysterious “anthropic principle” in astronomy is such a case, but a less mysterious case can be pointed out. The second law of thermodynamics seems to explain the direction of a series of events in terms of some better definable future condition, yet this could be explained away mathematically in terms of the asymmetry between a unique order and the infinity of the possible disruptions of this order, so that the change from the former to the latter is a virtual certainty, while the reverse constitutes a virtual impossibility. More recent finds in quantum physics make matters more problematic where the measurement of an outcome of an event seems to determine preceding or simultaneous (with all Einstein’s reservations here) series of corresponding events taking place or having taken place at distance.¹²

If Bell’s experiment showed the non-existence of a hidden variable and a possible exceptions to the Einsteinian “no action at a distance” principle, then where does this leave us in dealing with volition? It is no serious argument to say that since we have to accept the results of Bell’s experiment and live with action at a distance in the microworld, we have to live with volition as a mental act in the brain which causes actions to happen, yet has no event component.

We stated earlier that one of the advantages of the cognitivist revolution was the “naturalizing” of intentionality. It managed to do so by bypassing the old dilemma between “causes because of which” human actions happen, and “reasons for which” human actions happen: It turned the “having of reasons for action” into causes of action. Thus, the “having of reasons” occurs before the resulting behavior. Beliefs, purposes, decisions

found their place in explanation of human behavior as representations “in the mind” (which have their footing “in the brain”), occurring in the case of voluntary action before the behavior in question. It is a modern kind of *en-tel-echy* which provides support for folk (and, up to a point, psychodynamic) psychology. It did so by employing “representation”, a concept which presents serious ambiguity and obscurity problems. It could mean the “product” or the “process”, or indeed a peculiar quasi-semantic relation with dual footing both in the formal and the causal world which allows us to think compositionally and be connected to the world causally (KARGOPOULOS 2023).

7 Learned control leads from spontaneous movements to voluntary acts

Leaving the intricacies of representation to be clarified by cognitive science and expecting the glorious moment in which the specific coding of information in the brain will be revealed in such a way that the compositionality of information can also be explained, we can still clarify some of the essentials of freedom of the will taking into account an element that was left out of the original philosophical *problemata*, that of control of bodily movements and actions. Examining control of bodily movements and actions will help us see what is wrong with the philosophical problem of freedom of the will vs. determinism and will provide ways we can employ control in the direction of more, if not “free-er”, volition.

It is helpful at the start to avoid talking about freedom,¹³ will, thought, decision, impulse, determination, cause, reason, to avoid being lost in the ambiguities and the ambivalences they generate. Instead, we can start with what can be taken as given, the bodily movements. Mammals engage spontaneously in bodily movements, even before birth. We also take as given evidence of the neural mechanisms that are engaged in the production of bodily movements which later become behaviors and actions.

Let us begin by noting that if we examine phenomenologically all the verbs that describe human or animal activities (and “passivities”), from the most base to the most exalted, we find in all of them degrees of “voluntariness” that increase as control is increased. Ontogenetically speaking, the newborn infant exercises minimal control over any bit of behavior it emits. Its movements are jerky and often appear as a source of surprise to it. Some evidence of control is observed in the strong gripping of our finger which we invite the baby to take hold of, but this is an instinctive reaction in primates clinging onto their mothers.

Similarly, the fixing of the gaze that is measured in many developmental psychology experiments, is a reaction to outward stimulus. If there is any level

of action control at that early stage, it is limited, as with all mammals, to orienting on the breast and sucking on the maternal nipple which gives immediate and proportional-to-effort reward. Limb (hand, arm and foot) coordination follows. Other movements including crying and smiling initially happen to the baby, but they become gradually controlled by influence and interaction with the maternal responses.¹⁴

What follows these initial spontaneous bodily movements is a gradual gaining of variable control over most of them. In fact, with the exception of those we would like to think of as “passions” (that happen to us beyond, or even against, our volitions), most bodily movements (from the base suckling of the infant and up to the extremely controlled acrobatics of body, mind, and speaking tongue) are turned into actions and are experienced as such. Of course there are nervous ticks, hiccups, Tourette outbursts, and automatic reflex responses which are easily identifiable as “happening to us” (and not “our doings”), as there are ways that even these can be controlled to some extent, at times even predicted and prepared for, as in sneezing or yawning.¹⁵

There are two sets of truths to be born in mind concerning all these actions. To begin with, they are all learned. With practice most of them become easier, often done without thinking, or “second natures”, though sadly some are slowed down, hardened or even lost with age. In the second place, they can be easily classified in terms of degrees of voluntariness they involve, though this is only a phenomenological estimate that can vary between subjects.

As products of learning some degree of voluntariness varies within the individual subject as “practice makes perfect”.¹⁶ In the third place, what I called “degrees of voluntariness” should not lead to the idea that we are dealing here with a linear spectrum extending, say, from the zero or minimal control (which we have over dreaming or sneezing) to the full control of a carefully rehearsed ceremonial action. In fact, there are numerous kinds of control over actions and activities which make voluntariness a multidimensional space of variation. One such dimension is that of “effortfulness” vs. “effortlessness” of the activity in question as, for example, in carrying a light manageable weight vs. carrying a heavy or unruly bundle. Another is the need for the involvement of self-monitoring while the action is carried out, as in executing a series of steps of a routine for the first time, for example in learning a new dance (for which often a mirror is required).

Another is that of maximal vs. minimal engagement of consciousness or of attention in the activity.¹⁷ Yet another is the involvement of one vs. many senses (like vision or hearing) in the activity in question. Another is whether the whole

body is involved vs. only discriminable parts,¹⁸ as in skiing or bicycling vs. needling a thread. Finally, an all-important dimension is whether the action is carried out by the single person alone or as part of some social interaction involving other agents acting or responding to actions, with social dancing as paradigmatic example.

All these multiple dimensions in exercising control, when mixed with cognitive functions are further multiplied, as awareness of what our body does, undergoes, or suffers, changes with our knowledge or acquired experience, even for something as basic to any animal, as pain sensation. At its minimal contribution, the cognitive system offers memory of the immediate past and anticipation (in the light of experience) of the immediate future, turning thus any movement into action.

The second set of truths pertains to the organization of simple actions into more complex ones. Some actions appear to be simple and immediate actions (almost single muscle movement, like “bating an eyelash”), yet they seldomly are, a point we are reminded of, when what appears as simple as a sneeze can cause pain in other parts of the body considered as unconnected to happenings in the upper respiratory.

In general, many simple movements are organized into actions and experienced as such in a teleological fashion. Contrary to what is true from a mechanistic-physiological point of view, we do not move specific muscles in order to move our hand, instead the truth, as experienced by us, is closer to the reverse: we move many coordinated muscles by moving our arm,¹⁹ and we move our arm in order to reach, touch, grasp, move or engage in some way an object. It is the aimed end of the action that organizes the intervening actions and movements.²⁰

This happens not only with hand or arm muscles, but in all our muscular system (including muscles that do not seem to be related to voluntary movement), especially as it is connected to the nervous system in afferent and efferent direction combined in complex ways of effective and smooth control (“smooth” in the sense of appearing effortless, when we are not suffering from some local damage). It can be seen in the loss and regaining of one’s balance, either in accidental falls or in the normal controlled activities of walking or running.

Evidence for this second set of truths comes from many sources, besides the cited common experience. The most recent and dramatic such evidence comes from mirror neurons that are activated not when watching similar bodily movement but when watching similar completed action. Indeed, evidence of the achievement of the end of the action in question (i.e. hearing the sound of a piece of paper being torn) activates in the macaque brain the corresponding mirror neurons for tearing paper, even when the image is hidden behind a

screen (RIZZOLATTI & SINIGAGLIA 2006). This end-directedness of actions is also evident in the well-known pointing behavior that infants exhibit from early on (while its absence is used as early indication of autism). It is also the case that if one marks on the floor virtual footprints that indicate the point where the foot must land on the next movement, the Parkinsonian patient has less difficulty in achieving it, as Gomez-Jordana and colleagues stated in their 2018 paper. In the same light, it has been known for centuries that stutterers do not stutter when singing, perhaps because the connectedness of the tune guides the utterance of the lyrics, while any simple recitation of the same verses of the song brings back the stuttering problem.

Given this end-directedness of actions, the significance of the second set of the Libet experiments appears lessened, as hand flexing is not a normal end-directed action but the most minimal of actions, one step above a mere muscular response. Still Libet’s finding has to be taken into account, as it involves not just spontaneous motions, but the minimal voluntary acts that cannot be considered as mere reflex reactions (e.g. as is blinking of the eyes). From a scientific methodology standpoint, it is fully understandable that one has to start with the simplest of cases. On the other hand, repetitions of the Libet experiments have reconfirmed his results (SOON *et alii* 2008).

What must be explained are the many ways in which an infant starts to gain control over bodily movements, a procedure that continues through the person’s life. Moving one step beyond the instinctual mouth activity, Freud made much of the early control of bowel movements (and went on to characterize that stage of development as “anal”, with the well-known effect on personality development), and we know that parents must put some effort to help the child stop bed wetting. Significantly, such “skills” are lost because of illness or because of strong emotional responses (fright, for example). Sadly, they are often lost with serious illness or advanced age. To see graphically the slow gaining of control, it suffices to follow the differences in handwriting, starting from the five-year-old children learning to write, all the way to college age maturity, when they have to write quickly as a matter of course on a daily basis. It is also significant to see how this ease in writing is completely lost as a result of some brain stroke episodes. In these cases, physiotherapeutic recovery of the writing ability by engagement of other non-damaged neurons begins with a relapse to childish handwriting but leads eventually to the same personal handwriting, indistinguishable from the patient’s handwriting before the stroke.

What I am arguing for here is that the perceived or anticipated end of an action is what guides the motions of hands, limbs and body in

general and is assisted in that task by the well documented plasticity of the central nervous system. This process of learning proceeds by more and more focused control applied to the movements that begin as spontaneous bodily reactions and by way of becoming first actions and then voluntary actions, can end up even as mere objects of thought, when even the remembered or imagined or contemplated information that is emotionally charged (either in positive or in negative way) can produce an identifiable, analogous to the emotion caused, bodily reaction.

In general, even if thought does not originate an action, it influences an action after it occurs by often altering the performance of the similar action in a similar occasion in the future. For the sake of mental economy, we consider most actions as same as actions in the past. In fact, actions that are somehow significant for us to notice will not be encountered in the same way next time when the occasion arises. This generates our counterfactual belief that the action would not have happened if we had decided otherwise.

The phenomenon is generalized over all voluntary actions and becomes the basis of correct claiming or attribution of authorship of the actions, as we are aware of our past encounters with similar situations. In case of an obvious slip-up, we excuse ourselves by claiming momentary lack of attention or preoccupation with other concerns or other ways in which our consciousness was engaged at the time, so as not to recognize correctly the occasion that triggered the action.

8 Neural underpinnings of increased control and freedom

What allows for the exercise of control over movements is a complex interaction of many systems beginning with the general plasticity of neuronal synaptic connections as well as the growth of dendrites. In addition, on a higher level of interaction it is known that many reactions are governed by a dynamic balance of agonistic and antagonistic factors. On a yet more general level, the autonomous part of the peripheral nervous system is governed by the greater dynamic equilibrium between the sympathetic and the parasympathetic systems which act as to arouse the whole system and return it to normalcy accordingly. Given the plurality of substances and mechanisms involved, the organism has a multiplicity of entries upon which control can be learned and exercised. As many these are, or can be brought, under the attention of consciousness, the possibility of gaining further and better control is magnified.

Concerning the freedom of the will problem, the error lies in its very conception, which pits freely chosen acts as against causally determined ones and cites some mechanistic conception of univer-

sal causality as that which generates the incompatibility. What we know of the functioning of the central nervous system clearly leads to the assumption that all bits of behavior are causally determined, from the nervous tick or the hiccup to the most meticulously thought-out plot. To top it off, thought itself as experienced is causally determined because consciousness is causally determined. If there is a problem, and there is one, as any clinical psychologist would agree, it lies in the degrees and kinds of control we exercise over behavior. There are bits of behavior that cannot be controlled at all (like a hiccup or a ticklish person's response to tickling), others that can be controlled with some difficulty, as they give a small forewarning, like sneezing or yawning, others like crying or laughing, that can be blocked by engaging in some other bit of thought or behavior.

As we indicated earlier, control takes many different forms, so there is a variety of ways it can be exercised. Voluntary or free acts for which we take full responsibility belong to a special type of controlled behavior, one that involves thought and consciousness, in some cases even choice and decision between alternatives.

It is not that thought turns actions magically into free ones, as thought itself is determined and often uncontrollable. But as thought itself is subject to laws of syntax and semantics, it often proceeds in ways that are different to normal physical ways activities unfold. Syntax gives rise to other thoughts logically connected to the present thought which may assist bolden or even restrain an action. Semantics, as it is connected not only to general use but also to individual associations may affect an action positively or negatively. In any case, the illusion of a conscious volition starting and guiding every bit of voluntary behavior right after the thought, rests on the fact that behaviors that are learned seldomly, if ever, appear for the first time.

We recognize the stimuli and the occasioning circumstances of actions from previous encounters in the past, so our actions are not identical to what we had done in the past. Something changes both in what we notice and in what we anticipate. We know better. When we say that free will actions are a product of strong control that allows us to say (counterfactually) that it would not have happened had we thought or decided otherwise, we mean that we know ourselves passing through similar circumstances and all of them are such that we could have acted otherwise. This necessary addendum to the free act does not come before the act, but after the fact (and after the act). It is a statement of authorship of the action: "it all depended finally on me in a situation which I recognized as one in which I could contribute decisively".

In other circumstances where we are asked

why we did a specific action or even used a specific word, it is an honest reply to say “I did not think about it at the time”, or “I responded mechanically without thinking”, or “it didn’t occur to me that this word or action would offend or harm anyone”.

9 Basic tenets of the solution to the problem of freedom of the will

The above-mentioned ideas about freedom of the will and the significance of control can be summed up in the following points:

(I) Although Libet’s findings are limited to impulsive motions and reactions, we accept as a general principle that follows from them that nothing mental (like sensation, perception, awareness, attention, thought, decision) can occur, if no underlying biological events occur in the nervous system to which the causation of such mental events can be attributed.

(II) The first point appears to be in full support of the Wegner and Sapolsky theory that Freedom of the Will is an illusion and that Libet’s conjecture is erroneous. This would be the case only if by the phrase “freedom of will” we mean that some non-material thought had to precede the act and somehow cause the decision or the act to be at the level of the nervous system. This position is easily dismissed as anti-theoretical to (I).

(III) In the case of premeditated acts, mental events (series of considerations) have preceded which have affected the outcome of the acts and these thoughts, to the extent that they are subject to reasons, have syntactic and semantic relations to other thoughts and are influenced by them, but only to the extent that the agent has learned by experience or teaching to entertain such connecting thoughts and in the concrete case at hand has made them as a result of corresponding events in the nervous system.

(IV) Automatic movements and reactions (including instinctive ones) which could be taken as behavior or actions are relatively few. Analogously few are the acts fully premeditated and executed in ceremonial fidelity. The great part of the behaviors we consider as actions, or as composed of actions, for which we claim responsibility and are asked to justify by citing reasons, have a considerable degree of complexity, are results of learning, have involved real or potential mental activity that can be analyzed on the basis of the two archetypes of rationality: the teleological adaptation of means to the ends that the agent has somehow (con-

sciously or otherwise) chosen, and the formal rationality of following rules under which the acts or parts of the acts fall. Some of these rules are practical instructions facilitating the tasks we are engaged in, others are social norms that facilitate interactions with others, and still others may end up being moral codes that guide and vindicate lives.

(V) Human beings are born with no intelligence and no freedom and end up with some measure of both. As members of a natural kind (by way of evolution) and as members of wider communities (by way of history) they have created and live in environments which, in spite of small or greater setbacks, have led to increased levels of intelligence and freedom. For the individual human beings, intelligence is acquired gradually through development by way of learning that creates a new dimension in their lives. At the same time, freedom is achieved gradually through learning, memory, and especially through the exercise of control over thought, movement and action.

(VI) Learning, memory and control are the biological basis of intelligence and freedom which are founded on the plasticity of the central nervous system: it allows for behaviors to be modified, memories to be formed and shaped accordingly, which in turn are vital in recognizing similar circumstances which call for similar or different actions. Language acquisition amplifies this ability, allowing us to learn from the experiences of others or even from imaginary possibilities. It thus strengthens our claiming of a *mea culpa* responsibility: “this action of mine would not have happened if I had known, thought, decided differently”. This peculiar kind of counterfactual conditional does not rest its claim to truth trivially by virtue of the falsity of its antecedent; it rests on real connections (explanatory, that is: causal or rational) between what is contained in the antecedent and the consequent, to which the responsible agent has privileged access and could reveal and even defend adequately.

(VII) To our initial question concerning Libet’s conjecture as pitted against Wegner’s thesis (whether there is a neurally possible freedom of will), it follows from (I) that in the case of unmediated bodily movements or reactions, Wegner’s thesis is proven stronger, a point strengthened by Alvaro Pascual-Leone’s findings. We maintain however that there is an area of compromise between Libet and Wegner in the case of more complex mediated acts because they present more points where anticipation and control can be affected, depending on

the recognition of the circumstance that calls for the action in question. Even in the very special cases where a “split-second decision” is called for, as in a special operation for freeing hostages in a terrorist incident, the way this is done is not by a previous conscious decision of acting or refraining from acting, but as a result of training in simulated similar circumstances in which the trainee has to distinguish the hostage, the by-stander or the terrorist and react accordingly. This is not as dramatic as it appears, because in many sports analogous training is required as the velocities of a tennis ball, a baseball, or an ice hockey puck approach the 200 klm/hr which calls for immediate response in less than Libet’s half second. This happens more or less in many other sports. Those who only watch soccer games tend to think that kicking the ball is what carries the greatest significance (since this is how goals are attempted and scored). Those who have played soccer seriously know that greater significance must be assigned to controlling the ball.

(VIII) As there is no “highest good”, though it is always possible in any situation to point out what is better, in the same way there are no absolutely free actions (nor would we want to have any such, even if we knew what they are), but there are always freer actions, in other words: better controlled actions. The exercise of control is learned by experience, upbringing and education: we learn to control, create and guide thought, feeling, and action. The involvement of consciousness in these procedures becomes important not only as recognition of the possibilities of control, but also of the limits that must be kept between those that we do control and those which is better not to control absolutely, given the veil of ignorance covering what will happen to us and of the place we hold in the order of things. An absolutely controlled love affair is not a real love affair, as it involves no passion. In this way reflective consciousness becomes the basis for any “know thyself” wisdom and any real freedom we could achieve.

(IX) Finally, as to the problem whether there is freedom of will, the answer is a complex one, as is the case in many other philosophical problems (some of which have been solved, like the one concerning the innate or acquired nature of knowledge), and will be revealed in the details of research in neuroscience and cognitive science. There is no freedom in what the newborn human does, yet there exists in seminal form the potential for achieving more and more freedom in the mechanisms for controlling the movements of the infant, so that by op-

timization they are gradually transformed from initial reactions into learned responses, into new behaviors, into anticipation of results, into intentional actions. When later, by way of experience, language, education, and under vigilant supervision by the social surroundings, control is extended to the guidance of thought, desire, and action, then new possibilities for dimensions of freedom connected to self-consciousness are offered to the human being. This position, which considers that freedom of the will is conquered gradually, leads also to the position that not all humans are free to the same extent. This is not to be interpreted in the trivial sense of variable limits to economic and political power, nor by the equally trivial neologism of escape from social inhibition. Despite the many common elements in the structures and procedures of development, humans end up having not only different personalities, but also different intelligence and different unique consciousnesses which underlie their personalities.

This idea makes the task of developing a general theory of mind as well as a universal theory of consciousness more difficult, because intelligence and consciousness are interconnected to a high degree.

We propose a common universal beginning in the *qualia* of experience resulting from the interaction of the human baby with the surrounding reality. We consider *qualia* as not presenting significant differences in the various individuals, although we know that between different species and even between different members of the same species, there are significant individual differences in sensitivity (for example in “having a musical ear”), something we attribute to differing biological inheritance in the kind or in the individual.

On the other side of our inner life (from the biologically based *qualia*, that is) we postulate the “self” with its reflective consciousness, and although we see it as a universal characteristic of humankind, we still have no strong grounds to consider consciousnesses as uniform. As selves are developed between *qualia* and self-consciousness, the plethora of selves that would naturally result contributes to the recognition of the uniqueness of the solitary perspective from which each human being faces reality and contributes to what happens.

Deeper than the uniqueness of our appearance which after all is attributed to genetic combinations, is the uniqueness of our consciousness, which has a basis in biology, but also carries the history of its involvement with the world in which we have actively contributed not only by way of learning and memory (as any animal would), but also by taking reflective stock of who we are and who we chose to be, in light of our involvement in social and historical conditions.

10 Concluding epiphenomenal coda

Summing up then: we begin as infants with movements that are fully determined by causes out of our control. As we gain variable control over such movements, we turn them gradually into actions for which we take variable measures of responsibility. Our voluntary actions are those that involve maximal control since we claim counterfactual necessity for them: they would not have happened had we known, felt, thought, decided otherwise.

In other words, we are taking full (*mea culpa*) responsibility for them. Appropriately enough, the Greek word for “cause” (*aitia*) which started all this philosophical thinking, means “accusation/blame”, meaning that which is responsible for the event that happened and would not have happened without it. Our free acts then are those for which we have learned from previous experience that we could do otherwise, so that this act would not have been committed. This does not mean that the elements of acting involved (recognizing, remembering, thinking, willing, deciding) happened before the corresponding neural events. It only means that freedom of will is power to control actions in the light of our previous experience and it also means that epiphenomenalism, if it is not right from the start, it becomes right as mind, language, and thinking impose a new dimension to reality.

Notes

¹ Ignorance of the ways in which the many determining factors interact in multiple ways and affect human behavior is considered by Spinoza as the source of our belief in the freedom of the will.

² The term “fact” is used here in a phenomenological, not ontological sense: we experience exercise of free will at least in choices between alternative courses of action, where “reasons for” are employed as effective over any other factor in leading to the act in question. Our initial choice is often altered by some thought (which occurred to us or was provided by others) which we had not considered at the outset. It is generally accepted that some ideas beget action plans, while other ideas thwart the execution of said planned actions.

³ Existence of a previously occurring thought cannot by itself be the basis for establishing exceptions to determinism, as it is a known fact that thought itself, though often described as free, is determined by neural events which often stand contrary to our volition, as shown in the universally experienced difficulties of suppressing nagging, unpleasant thoughts, or even silly repetition of tunes. Thought suppression of challenging thoughts (e.g.: “do not think of a polar bear in the next minute!”), though not as inescapable as, say, a cough, a laugh, a tear, is not always an easy task.

⁴ We know how quickly loss of consciousness occurs when less than the required amount of blood (below 97%) reaches the brain as a result of orthostatic drop of blood pressure. By “higher process” we mean that it in-

volves other processes (attention, sensation, perception, thought) which engage many separate regions of the brain and not the activation of some single “consciousness nucleus” of the brain.

⁵ Related verbal expressions: “avoid”, “block”, “cause not to happen”, “thwart”, “frustrate”, “restrain before doing”. We will use “refraining” in contrast to “performing” as general synonym for “intentionally not doing”.

⁶ It is important to note here that this a clear case in which a scientific result undercuts a philosophical analysis. What is overturned is the general position that all refrainings are mediated. It is still possible to refrain from an action by doing something else, for example, some people refrain from smoking by chewing gum, monks use rosaries to keep praying and thus refrain from allowing “unholy thoughts” to enter their consciousness. Cases like these show sufficient, not necessary conditions of refraining.

⁷ There is evidence of shorter reaction times for countermanding (which leads to refraining) vs performing in macaque monkeys, when appropriate rewards are given or denied. What should be noted here however is that the performing or refraining is reinforced or not reinforced by an appropriate signal and thus they are learned responses (cf. SCHALL *et alii* 2002). I’m grateful to Dr. A. Moshovakis for bringing Scahl’s paper to my attention.

⁸ Which is used often as a legal ploy to turn “murder” or “manslaughter” charges into “accidental homicide” ones.

⁹ The “easy way out” of suggesting that Aristotle erred by not accepting the possibility of actual infinity, or of an eternally ongoing motion, is not intellectually iron tight. We can (and often do) wonder, for example, about what preceded the singularity of the Big Bang, though we know that such musings can only lead to mere conjectures which could never be tested experimentally, as time and natural laws themselves (which have to be used in any experimenting) are thought to be generated by the singularity of the Big Bang.

¹⁰ In all fairness to Aristotle, let’s remember that of all four causes (material, formal, final, efficient) the first three are in the substance (thing) in question as essential properties (hence *en-tel-echy*, i.e. the having of ends inside the “primary substance” or individual thing), while the efficient relates something to what is outside of it and has acted before the changes of the thing in question. So, the idea of God as the final cause of motion of the universe leaves open the possible interpretation of a God-in-nature guiding its development towards an end-state.

¹¹ For any organ of the body, say the pancreas, and for any organic structure, say eyebrows, or appendix, or nipples in males, it makes good sense to ask at the outset what purpose (or function) they may serve. Concerning entelechy, what embryologists have observed in every stage of early development, especially in the case of the nervous system, seems as an absolute vindication of an orchestrated entelechy.

¹² Inspired by experiments showing entanglement over time, not just space, Vedral (2022) is reconsidering the way we think of time in quantum mechanics which could make quantum time travel possible. I am indebted for much information on quantum mechanics to discussions with a former colleague from the Physics Department of Aristotle University of Thessaloniki, Dr. Christos Panos.

¹³ Which, even in the neutral conception of freedom as

“possibility for unimpeded motion”, admits of 256 different interpretations, as Richard P. McKeon argued in his seminal paper *Philosophic semantics and philosophical inquiry*.

¹⁴ The supposed ability of newborn babies to imitate the facial grimace of the person facing them, an ability which is subsequently lost to be properly regained later in development, if true, is too complex to be classified even as due to imprinting, which is acquired and remains as part of the behavioral repertory of the animal. If true then, this mirroring has to remain as part of the mystery of how instinct operates.

¹⁵ Biofeedback seeks effective ways of controlling even physiological functions. But even in cases of epileptic seizures or psychotic episodes, subjects can be trained to anticipate them and thus prepare accordingly.

¹⁶ One can recognize at a first glance the “seasoned” driver, or smoker, or (in general) any such practitioner, from the novice.

¹⁷ The muscles controlling tongue movements, for example, must exercise precise control to get out of harm’s (i.e. teeth’s) way without conscious attention. This control is lost in cases of local anesthesia often used during dental operations, or in epileptic fits. In general, the accidental biting of the tongue is too rare a phenomenon, given the frequency of the chewing activity.

¹⁸ We think of a pianist’s actions as involving finger-hand-arm movements and pedal pressing by one foot, in immediate cooperation with hearing. Arthur Rubinstein insisted on the importance of the control and involvement of breathing in the interpretation of piano pieces, something one would only expect in wind instruments or vocal performances. Which makes sense because breathing is controlled in two ways, a voluntary one (say in singing) and an involuntary one (during sleep).

¹⁹ Because we know how to move hands and arms, not how to move individual muscles, unless we belong to that minority who spend time exercising and building muscles (and they acquire control of individual muscles by watching muscle activity in the mirrors). In that same category we can include those few who have somehow learned how to wiggle their ears

²⁰ Many projects of “sports science” consists of the exact opposite: analyzing complex acts into simpler component movements, so that by improving on these details, we can improve overall performance, for example in throwing a javelin. Of course, other factors, such as breathing or pacing oneself are also taken into account, as is the motion and interaction with the employed apparatus (balls, paddles, rackets, swords, baseball bats etc.).

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