

energija u umjetnosti
napetost i promjena strukture
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energy in art:
tension and change of structure
by: antonio šiber

Jezik kojim se koristimo koristan je samo ukoliko mentalne slike koje priziva odgovaraju stvarnosti koju pokušavamo opisati. Mentalne slike koje priziva riječ "pas" ne ovise uvelike o slušaču ili govorniku, što nije slučaj za riječi "sloboda", "ljubav" ili "energija". Vrlo je upitna kvaliteta komunikacije međusobnog razumijevanja kad iste riječi nužno različitim sugovornicima prizivaju različite mentalne slike. Stoga je oduvijek prisutna potreba da se riječi "dogovore" ili "definiraju" jednostavnijim pojmovima kojim zazivaju iste mentalne slike različitim sugovornicima, pojmovima koji pretendiraju biti univerzalno ljudski i neovisni o jeziku kojim pojedinac govori ili kulturi iz koje potječe. Prirodne znanosti, pogotovo fizika predstavljaju vrlo jasan i krut okvir za ovakve dogovore. Pojam iz svakodnevnog jezika "uvozi" se u jezik fizike i definira zakonitostima i definicijama koje nužno osiromašuju konkretni pojam, ali ga i čine neovisnim o onome tko ga koristi. (Trebalo napomenuti da je pojam energija, kojim se ovaj tekst bavi, zbilja postojao u svakodnevnom jeziku i da ne potječe iz specifičnog jezika fizike. Grčka riječ *energeia* može se naći deset puta u Novom Zavjetu, prevedena u engleskoj verziji kao "energy" (energija), "working" (rad, djelovanje) "operation of a power" (djelovanje snage). Interesantno je konkretni pojam nakon ovakvog redefiniranja "izvesti" natrag u svakodnevni jezik ili neko drugo područje u kojem se pojam koristi. To je ujedno i plan ovog izlaganja, skiciran na slici. Mogli bismo, barem naivno, očekivati da će se pojam i unutar tog drugog područja barem djelomično "depersonalizirati" i time postati općenitije razumljiv. Upravo ću ovakav pothvat učiniti i ja izvozeći pojam energije iz područja fizike u područje umjetnosti. Energija se u fizici definira kao sposobnost obavljanja rada, pri čemu je rad mehanički definiran kao djelovanje sile (ili svladavanje sile otpora) na određenom putu (ovdje treba uočiti da je fizikalna definicija energije zadržala osnovne značajke grčke riječi *energeia*: en - u i ergon - rad). Na primjer: Ako se jako zaletite na koturaljkama, vi transformirate energiju svojih mišića (djelovanjem sile i obavljanjem rada) u energiju gibanja. (Jasno je da je energija vezana uz gibanje. Na primjer: metak koji se zaustavi u materijalu napravi u njemu rupu transformirajući svoju energiju gibanja u rad potreban da se rupa napravi.) Nakon prestanka uporabe mišića postignuta energija gibanja troši se na rad na svladavanju sile trenja na putu zaustavljanja.

The language we use is useful only if the mental images it summons correspond to the actuality we are trying to describe. The mental images summoned by a word "dog" do not significantly depend on the speaker or the listener, which is not the case for words "freedom", "love" or "energy". The quality of communication and mutual understanding is questionable when the same words summon different mental images to necessarily different communicators. Therefore, there has always been a need to "agree upon" or "define" words through simpler words/concepts which summon "the same" mental images to different communicators. These simple words or concepts tend to be universally human in nature and independent of culture or language of a particular human. Natural sciences, especially physics, represent a firm and clear frame for definitions of concepts. The concept from everyday speech is "imported" into the language of physics and defined through physical laws and definitions. This procedure necessarily impoverishes the concept, but it also makes the concept independent with respect to the one who uses it. (It should be mentioned here that the word energy, which is of interest here, really existed in everyday language and that it does not come from the language of physics. The Greek word *energeia* is repeated 10 times in the New Testament and translated in the English version as "energy", "working" and "operation of a power".) After this "redefinition procedure", it seems interesting to "export" the concept in question back into the everyday language or into a language used by a specific community. This is also the plan of this elaboration sketched in the figure. We could (at least naively) expect that the particular concept will have a meaning which is less independent on a speaker (listener). In what follows, I will try to export the concept of energy from the language of physics into the language of art. Energy in physics is defined as the ability or capacity to do work. Work is defined as an action of a force on a certain path (one should note that the physical definition of energy contains the basic ingredients of the Greek word *energeia*: en - in + ergon - work). I will make this definition more obvious on a simple example: If you run on roller skates, you transform the energy of your muscles (by applying force and doing work) into the energy of your motion. (It is clear that there is energy in motion. Take a bullet for example: it makes a hole in the object it hits by transforming its motion energy into work needed to make the hole.) After you stop using your muscles, the energy of motion you had is spent on working against the friction force on your stopping path. This work actually transforms into heat: the wheels of your roller skates are warmer.

Taj se rad u stvari transformira u toplinu: kotačidi su vaših koturaljki topliji. Toplina je još jedan oblik energije gibanja i vezana je uz kinetičku energiju gibanja molekula nekog tijela. Osnovni zakon fizike skriven je u prethodnim primjerima. Zakon očuvanja energije kaže da je energija u zatvorenom sistemu (tj. sistemu koji ne međudjeluje sa svojom okolinom) konstantna (ne mijenja se u vremenu). To znači da svaki rad učinjen u zatvorenom sistemu samo preraspodjeljuje energiju u sistemu (za obavljanje rada potrebna je energija: u zatvorenom sistemu ta se energija mora uzeti iz sistema i radom "prenijeti" nekamo drugamo u sistem). U ovom jednostavnom primjeru vidimo da je riječ energija upotrijebljena na dva različita načina. Jedan je energija gibanja iii kinetička energija, a drugi je "energija mišića". Energija mišića primjer je potencijalne energije tj. energije koja je pohranjena u specifičnoj konfiguraciji sistema koja nije ravnotežna i koja se može transformirati u ravnotežnu, minimalno energetsku konfiguraciju izmjenom energije s okolinom iii transformiranjem potencijalne energije u kinetičku. U ovom sludaju radi se o energiji pohranjenoj u molekuli (adenozin-trifosfat, ATP) koja se u kemijskoj reakciji transformira u jednostavniju molekulu (adenozin-difosfat, ADP) s manjim sadržajem energije. Jednostavniji primjer potencijalne energije gravitacijska je potencijalna energija. Tako tijelo na nekoj visini iznad zemije ima konačnu potencijalnu energiju zbog svog položaja u odnosu na površinu zemije (ovdje je potencijalna energija opet vezana uz specifičnu konfiguraciju sistema koja je neravnotežna). Padanjem tijelo svoju potencijalnu energiju transformira u energiju gibanja (kinetičku energiju) koja se udarom o tlo transformira u rad na svladavanje otpora tla. Doslovna primjena fizikalnog pojma energije na umjetničko djelo moguća je. Svako umjetničko djelo treba medij kojim se prenosi promatraču. Slika treba platno i boje, glazba treba zrak da bismo je čuli. Glazba treba i izvor koji je proizvodi. Film dolazi do nas putem elektromagnetskih vabova koji maju energiju. U stvari, za svaki naš doživljaj potrebna je konačna energija vezana uz sam nastanak senzacije i prenošenje te senzacije do mozga. Postoji fizikalni aspekt energije vezan i uz umjetničko djelo i uz promatračevu percepciju tog djela. Međutim, ovakva primjena pojma energije dovela bi nas u očigbedni apsurd. Tako bi na primjer više energije imala teška slika ili glasnija glazba.

Heat is another form of motion energy. The more vigorously molecules of a particular body move, the more heat (and temperature) it has. There is a basic law of physics hidden in this example: The law of conservation of energy which says that the energy in a closed system (this means that the system does not interact with its neighbourhood) is constant (does not change with time). This means that all the work done in a closed system simply rearranges the energies contained in the system (you need to have energy to make work: in a closed system you must use energy from somewhere within a system). In the simple example I used to explain the physical concept of energy, I used word "energy" in two different ways. One is "energy of motion" or kinetic energy and the other is "energy of muscles". Energy of muscles is an example of potential energy i.e. the energy contained in a specific configuration of a system. This configuration is not in equilibrium and can be transformed into an equilibrium configuration with lower content of potential energy by transforming some of potential energy into kinetic energy or by exchanging some of the energy with the surrounding systems (neighbourhood). In our case there is potential energy stored into the chemical configuration of adenosine-triphosphate (ATP). ATP transforms into adenosine-diphosphate (ADP) via a chemical reaction which releases energy. This is the source of energy we use for our daily activities. A simpler example of potential energy is gravitational potential energy. A body at a certain height above the surface of the Earth has finite potential energy. Note that potential energy in this case is again related to the configuration of the system, which is not in equilibrium, which would be a body touching the Earth surface. By falling, the body transforms its potential energy into kinetic energy which transforms into work done against the resistance force when the body hits the ground. A strict application of the physical concept of energy on a particular work of art is in fact possible. Every work of art needs some kind of a medium or substance in order to be presented to a viewer. A painting needs paints and paper or some other material, music needs air in order to be heard, it also needs a source (of energy) which produces it, we see a movie due to the electromagnetic waves (which have energy) produced in its reproduction. In fact, every sensation we feel needs finite energy to be transported to the brain. There is a physical aspect of energy related both to the work of art and to viewer's perception of it. However, a strict application of a physical concept of energy to the works of art would lead to absurd conclusions.

Činjenica da je za pokretanje raznih čudnovatih strojeva u nekom performansu potrebna količina energije (a ovdje zbilja mislim na fizikalni pojam energije - ono što vam naplaćuju svakog mjeseca i mjere u kilovat-satima) koju prosječno kućanstvo potroši godišnje, još uvijek ne znači da je konkretni performans energičan - on samo treba ogromnu količinu energije za postojanje. Kad za umjetničko djelo kažemo da "ima energiju" (ili da "zrači energijom") sigurno ne mislimo na ovakve, osnovne aspekte njegova postojanja. Za krutu, fizikalnu karakterizaciju energije umjetničkog djela, promatrač nije niti potreban (kao ni umjetnost uostalom), pa je pojam energije zbilja depersonaliziran i univerzalan, ali sigurno ne odgovara istom pojmu u jeziku umjetnosti. Energičnost umjetničkog djela očigledno je vezana uz karakter percepcije promatrača. Jasno je da smo priznajući ovu činjenicu prihvatljivo. No samu percepciju promatrača možemo promatrati s fizikalnog, preciznije rečeno mehaničkog, stanovišta pokutavajući istaknuti analogije između karaktera percepcije i osobina jednostavnih fizikalnih sistema. Percepcija gibanja (pa onda i energije gibanja) u umjetničkom djelu donekle je neovisna o promatraču kad se radi o djelima koja se realiziraju i u vremenu, a ne samo u prostoru. Tako bismo npr. za jedan jedini konstantni ton kazali da ima mnogo manju kinetičku energiju od melodije. Ovdje je kinetička energija vezana očigledno uz mijenjanje strukture, oblika kroz vrijeme gibanje. Slično je i s glumcima ili plesačima na sceni. Svako gibanje, naravno, nije isto. Tako bismo mogli reći da je gibanje (ili energija) ritmično ako se određene konfiguracije odnosno strukture, javljaju opetovano u manjeviše stalnim vremenskim razmacima, analogno gibanju njihala primjerice. Problematičnije je definirati kinetičku energiju djela koja se realiziraju samo prostorno, npr. slike ili skulpture. No sama je percepcija slike proces koji traje konačno vrijeme, pa bismo kinetičku energiju slike mogli vezati uz vremensku promjenljivost njene percepcije. U stvari, jasno je da se promatrača ne možemo "riješiti". Energija umjetničkog djela vezana je kako uz aspekte umjetničkog djela koji ne ovise o promatraču, tako i uz karakter promatračeve percepcije tog djela. Potencijalnu energiju umjetničkog djela mogli bismo definirati kao energiju pohranjenu u strukturi (ili strukturama) tog djela. Percepcija potencijala strukture (konfiguracije, forme) ovisit će kako o promatraču tako i o samoj strukturi.

For example, a heavy painting would contain more energy than the light one. A loud piece of music would always have more energy than a silent one. The fact that weird machines used in some performance need energy (and here I mean physical energy of the kind you pay for every month and which they measure in kilowatt hours) spent by an average family in a year, does not mean that the performance in question has artistic energy; the machines just suck up energy much in the same way a washing machine does. When we say for a piece of art that it has energy or that it "radiates energy" we surely do not think about the strict physical aspects of its existence. For a strict physical characterization of a work of art, a viewer is in fact not needed (the fact that we talk about the work of art and not a piece of paper is also of no importance at all), which makes this concept of energy in art universal. The energy of (in) the work of art is clearly related to the character of the viewer's perception of the work of art. By accepting this fact, we must abandon any hope to say something universal and widely accepted concerning the energy in art. However, the viewer's perception can be looked at in its physical (more precisely mechanical) aspect, trying to find analogies between the character of perception and the properties of more or less simple physical systems. The perception of motion (i.e. kinetic energy) in a work of art is to a point independent of the viewer when we speak about the works which exist in finite time and not only in finite space. We could say for a single constant tone that it has a much smaller kinetic energy than a melody. The kinetic energy of a work of art is clearly related to the change in structure or form through time: motion. Much the same holds concerning e.g. dancers or actors on a scene. Every kind of motion is not the same. We could say that motion (or energy) is rhythmic if particular configuration, structure repeats itself in more or less constant intervals, analogous to the motion of a pendulum for example. It is more difficult to define kinetic energy of works which do not change in time and which exist only in space, such as paintings or sculptures. However, perception is a process which lasts a finite time and we could define kinetic energy of a static work of art as a temporal change of its perception. In fact, it is clear that we can not "get rid" of a viewer. The energy of the work of art is related both to the aspects of the work of art which are independent of a viewer and to the viewer's perception of the work. Potential energy of the work of art could be defined as energy stored in its structure (or structures).

Povlačeći analogiju s potencijalnom energijom u fizici mogli bismo reći da potencijalnu energiju imaju strukture koje su "neravnotežne", napete, koje se imaju tendenciju gibanjem relaksirati u ravnotežnije strukture kao što se napeta žica gitare ima tendenciju relaksirati gibanjem u svoj ravnotežni položaj čim maknemo prst s nje. Ovdje je zgodno citirati Jurija Alschitza (Lectures on "Theatre in the 21st Century") koji osim problema jezika, spomenutog u uvodu ovog članka, diskutira i pojam energije koju shvaća kao napetost (dakle, njegovo viđenje energije u kazalištu vjerojatno odgovara viđenju potencijalne energije skiciranom ovdje): "Nemamo samo probleme s različitim religijama, mi govorimo različite jezike, različite kazališne jezike. Posjetio sam niz radionica tijekom ove konferencije i nisam razumio o čemu se raspravlja. Primijetio sam da riječ energija u stvari znači napetost." Promatrač se pojavljuje kao svojevrsni referentni nivo za mjerenje potencijalne energije slično kao što će kamen pušten s visine od 1001 m osloboditi veliku količinu svoje potencijalne energije padom u more ali samo malu količinu padom u planinsko jezero na visini od 1000 m. Mogli bismo spekulirati da se napetost strukture umjetničkog djela prenosi u napetost promatračeve neuralne mreže koja percipira djelo. Taj prijenos ovisi o stanju neuralne mreže u trenutku percepcije (što znači da je percepcija uvjetovana iskustvom, znanjem i poviješću promatrača). Slično poimanje energije umjetničkog djela (pleas) u terminima napetosti možemo naći i u iskazu Jelene Petrović (Alternative Energy, Dance, Vol 19, Issue 332, 1998): Energija u plesu vezana je uz ideju da je prostor preuzak za ono što se zbiva, da pokret, ma kako mali bio, curi kroz vidljive granice tog prostora." Ovdje je energija vezana kako uz gibanje (kinetička energija) tako i uz napetost prostornih struktura koje to gibanje proizvodi (potencijalna energija). Gibanje i napetost strukture čine se tijesno povezanim. Slično kao i u mehanici gibanje vodi do različitih struktura (odn. promjena strukture uzrokuje gibanje) koje imaju različite potencijalne energije, napetosti. Na kraju, svjestan sam da je proces "izvoza" pojma energije iz fizike u umjetnost koji sam skicirao u ovom članku bio vrlo osobno obojen i uvjetovan. No program definiranja pojma ispunjen je redukcijom pojma energija na jednostavnije i vjerojatno jasnije pojmove gibanje, forma, struktura, konfiguracija i napetost.

The perception of the potential of a particular structure (configuration, form) will in general depend both on the viewer and the structure. As with potential energy in physics, for the structures which are out of equilibrium (balance), which are "tense", which have a tendency to relax through motion into more balanced structure just as a strained guitar string has a tendency to relax by oscillating around its equilibrium positions, we could say for such structures that they have potential energy. It is interesting to cite Jurij Alschitz here (Lectures on "Theatre in the 21st Century") who, besides the problem of language mentioned in the introduction of this article, speaks about the concept of energy which he understands as tension (this means that his understanding of an energy in theatre probably corresponds to the notion of potential energy sketched here): "We don't just have a problem with the various "religions", we also speak different languages, different theatre languages. I have visited a number of workshops during this conference and haven't understood what was being discussed. The use of the word "energy", I have noticed, stands for "tension". The viewer appears here as a kind of a reference level for measuring the potential energy: A stone which falls from a height of 1001 m releases a large amount of its potential energy when it falls into the sea but only a small amount when it falls into a mountain lake on a height of 1000 m. One could speculate that the tension of the structure of a work of art translates into a tension (potential energy) of viewer's neural network which perceives the work and that this translation depends on state of the neural network at the time of perception (this means that perception is influenced by experience, knowledge and history of the viewer). A similar understanding of energy in art (in terms of tension) can be found in an article by Jelena Petrović (Alternative Energy, Dance, Vol 9 Issue 332 11998): "Energy in dance has to do with the idea that space is too tight for what is going on, that the movement, however small, leaks through its visible boundaries." The energy as comprehended by J. Petrović is related both to motion (kinetic energy) and to tension of spatial structures produced by motion (potential energy). The motion and the tension of structure are tightly connected. As in mechanics, motion leads to various structures (or the change in structure leads to motion) which have different potential structures or tensions. At the end, I am aware that the process of "exporting" the concept of energy from physics into art I sketched in this article was very personally coloured. However, the program of defining a concept of energy through its reduction to simpler and clearer terms of motion, form, structure, configuration and tension was fulfilled.