

## Appendix

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## Appendix 1

All results, elicited from each lecture, are presented below. The numbers to the left are representing one antithesis. All tables are the same as the presented ones in the analysis: the excerpt, a categorization of opposition, if the antithesis is active or not and whether it is spatial in some sense. Below the excerpt, a short comment on the excerpt follows. Regarding Südhof, the rest of the antitheses which did not fit in the analysis are presented here

### HIV: A DISCOVERY OPENING THE ROAD TO NOVEL SCIENTIFIC KNOWLEDGE AND GLOBAL HEALTH IMPROVEMENT

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This Nobel lecture was held by Françoise Barré-Sinoussi 7<sup>th</sup> December 2008<sup>©</sup>. She discusses HIV, how it was discovered and its relation to other viruses.

	Antithesis	Sub-group	Active	Spatial
1	“when the INITIAL clinical observations (...) the first cases of what would LATER be known as AIDS” (p. 251)	contrary opp.	No	Yes (orient.)
This antithesis is not active since the antithetical pair is not intrasentential, neither parallel. It is however contrary in the sense that it describes a point in time that can be placed on a linear scale (hence it also belongs to <i>orientation</i> ). “Initial” implies a start, and then “later” describes another point in time which happens in the future, and another point in time is gradable entity, hence a contrary opp.				
2 3	“we have learnt that HIV infection is much more complex than we INITIALLY [a] thought, and the mechanisms leading to AIDS pathogenesis ARE STILL TODAY NOT [b] entirely understood. We HAVE, HOWEVER, GAINED SINGIFICANT INSIGHT [a] into the virus and the evolution of the disease it causes; for example we NOW [a,b] know that soon after infection by HIV, the virus integrates into the host cells” (p. 253)	contrary opp.	Yes	Yes (orient.)
Both antitheses in the excerpt are contrary opp. and describe what one knows today, in comparison with what one thought before. Due to both being explicit, they are active. Since both entail time, they belong to <i>orientation</i> .				
4	“indeed the PEAK of viral load correlates with a SHARP DECREASE” (p. 253)	contrary opp.	Yes	Yes (motion, orient.)
This active antithesis is a contrary opposition which deals with length, an entity that is gradable. Due to its gradability, it is a contrary opp. and furthermore, since it entails a vertical direction, it belongs to <i>orientation</i> .				
5	“Equally different genetic polymorphisms of RECEPTOR, LIGANDS and key immune proteins all result in specific modulations of the host response to HIV infection” (p. 254)	correlative opp.	Yes	No/Yes (motion, space)
The antithesis is an active correlative opposition, comprising the relationship between the molecular expressions and structures “ligand” and “receptor”. These are however <b>not</b> correlative opp., nor active if one is not familiar with these expressions. They can be both regarded as non-spatial conceptual antitheses, as well as spatial conceptual antitheses. From a lexical perspective, they are simply not but if regarded as for what the notions stand for these are structures in space which are in close relation because a ligand bind to its receptor, and therefore these antitheses could belong to <i>motion</i> and <i>space</i> .				
6	“Recently it has become apparent that HUMANS and NON-HUMAN PRIMATES possess a number of	contradictory opp.	Yes	No

	proteins” (p. 254)			
This antithesis is active and consists of a contradictory opp. comprising a dichotomous pair – humans versus non-humans (primates). It is not a spatial conceptual antithesis since it is difficult to correlate it to <i>motion</i> , <i>orientation</i> and <i>space</i> .				
7	“TWO groups of intravenous drug users (IDU) who routinely exchanged needles for drug injection. Despite both groups being infected with hepatitis viruses and HTLV, ONE group was consistently negative for HIV ” (p. 254)	contradictory opp.	Yes	No
This antithesis (active) depicts a contradictory opposition, because it is either the one group or the other (the group which becomes infected with HIV and they one which does not become infected).				
8 9 10 11	“The analysis revealed an INCREASED [a] ratio of specific NK RECEPTORS IN EU compared to CONTROL or HIV INFECTED INDIVIDUALS [b]. Furthermore, the functional activated NK CELLS IN EU [d] express significantly HIGHER [c] levels of the CD161 receptor than [d] CONTROL INDIVIDUALS [b]” (p. 254)	a,c. contrary opp. b. intermediate d. contradictory opp.	a,c. No b,d. Yes	a,c. Yes (orient.) b,d. No
Both antitheses [a] and [c] are a non-active contrary opposition because they comprise increase/decrease and higher/lower respectively, only “decrease” and “lower” are implicit. They are gradable antitheses, hence contrary. Moreover, because they are gradable, they can be interpreted as abstract linear scales which correlate to <i>orientation</i> . [b] constructs an active intermediate because it discusses multiple different individuals. [d] is also active but comprises a contradictory opposition, since here only two different groups of individuals are compared. These different individuals or groups, are not spatial conceptual antithesis.				
12 13	“Further analyses showed that the CD8 T cells of HIV CONTROLLERS [a] were activated, but TO A LESSER EXTENT than in HIV PROGRESSORS [a]. Although the majority of HIV controllers appear to possess suppressive CD8 T cells [b], some individuals ARE NOT[b] characterized by this trait, while still efficiently controlling the virus” (p. 255)	a. contrary opp. b. contradictory opp./intermediate	Yes	a. Yes (orient.) b. No
[a] is an antithesis in the sense that it discusses how active the CD8 T cells are in the “HIV controllers” as well as in the “HIV progressors”. Because it entails the gradability of activity, it is a contrary opp. Since the gradability can be illustrated by a linear path, it belongs to <i>orientation</i> . [b] is a contradictory opp. since it describes what is and what is not: the majority of HIV controllers possess suppressive CD8 T cells, whereas as others do not. Since “the others” (“some individuals”) is not specified, [b] is an intermediate as well. It is not spatial.				
14	“the African Green Monkey (AGM) DO NOT DEVELOP AIDS, in contrary to the Asian Rhesus Macaque” (p. 255)	contradictory opp.	Yes/No	No
This antithesis is a contradictory opposition since it, as described above, entails a negation, a direct opposite. It is active in the sense that the different monkey species are being compared, but it is being compared by “in contrary” and not by the more evident antithesis “develop”. It is not spatial.				
15	“in both PATHOGENIC and NON-PATHOGENIC” (p. 255)	contradictory opp.	Yes	No
This is a contradictory opp. since one of the antithesis is the negation of the other (even though non-pathogenic actually comprise all but pathogenic – therefore, form one point of view, it could also comprise a intermediate). The antithesis is active but not spatial.				
16 17 18	“COMPARATIVE ANALYSES [a] between the two primate models show that T cell activation during the chronic phase of viral infection is a KEY DIFFERENCE [b] between the NON-PATHOGENIC and the PATHOGENIC [c] infections” (p. 255)	a. intermediate/ contradictory opp. b. intermediate c. contradictory opp.	a,b. No c. Yes	No
This excerpt is somewhat complex to discuss. The expression [a] is an antithesis in the sense that by introducing this comparison between the two primate models (African Green Monkey and Asian Rhesus Macaque) [b] and [c] can exist. It is contradictory because it entails these two primate groups, but it is simultaneously an intermediate because it does not specify which analyses that have been used. [a] is neither an active antithesis,				

nor a spatial one and this applies for b as well. [b] is antithetical in the sense that it highlights what “key difference” there is between the groups. However, other differences are not included here which makes [b] an intermediate [c] is a contradictory opp. due to that one of the antithesis is the negation of the other and hence comprises a dichotomous relationship. The last antithesis [c] is active since both antitheses, comprising the pair, are explicit in the excerpt. [c] is not spatial.				
19 20 21	“This suppression is only PARTIALLY RELIEVED [a] by incubation with MONOCLONAL ANTIBODIES [b] against HLA class 1 (the natural ligands of CD85j) but STRONGLY ABOLISHED [a] by incubation with A RECOMBINANT [b] CD85j protein, suggesting that the interaction between the CD85j RECEPTOR [c] and a peculiar (as of yet unknown) LIGAND [c]“ (p. 256)	a. contrary opp. b. contradictory opp. c. correlative opp.	Yes	a. Yes (orient.) b. No c. Yes (motion)
All antitheses are active. [a] is a contrary opp. since it deals with suppression which is gradable – in the first antithetical element, the suppression is “partially relieved”, and in the second, the suppression is “strongly abolished”. Due to that it comprise gradability, the antithesis is thus a contrary opp. and belongs to <i>orient</i> . [b] consists of the pair “monoclonal antibodies” and “recombinant CD85j protein” – a pair that is not an evident antithesis, but still is in this context, since it in both cases deals with incubation. It is not spatial. For [c], please see antithesis 5.				
22	“At the end of 2007, 33 million people WERE LIVING with HIV, 2,7 million were NEWLY INFECTED and a further 2 million DIED of AIDS” (p. 257)	contrary opp.	Yes	Yes (orient.)
This antithesis deals with how many that are/becomes/ and have been infected by HIV (or AIDS in the case of death) in correlation with a time-span. It can be interpreted as having two poles, where the direct opposites are “alive” (were living) and “dead” (died), and in between these two, the “newly infected” can be put. Due to this “gradability”, the antithesis is a contrary opp. Because of the gradability and time, it belongs to <i>orientation</i> . For reasons why, see elsewhere regarding contrary opposition and time.				
23	“Despite the immense BENEFITS of ARV treatment, many ISSUES still need to be tackled” (p. 257)	contradictory opp.	Yes	No
This antithesis deals with benefits as well as issues, a pair which can be interpreted as a contradictory – hence the antithesis is a contradictory opp. It is active but not spatial.				
24	“Prevention programmes which are currently being investigated include PRE- and POST-EXPOSURE” (p. 258)	contradictory opp.	Yes	Yes (motion, orient.)
This is an active antithesis which comprises a time spectra, dealing which what was before and after exposure. Since it depicts two dichotomous states, it hence is a contradictory opposition. Because it deals with both movement as well as a vertical direction (because of “time”) is belongs to both <i>motion</i> and <i>orientation</i> .				
25	“HIV is transmitted not only by CELL-FREE virus, but also by CELL-TO-CELL contact” (p. 258)	contradictory opp.	Yes	Yes (motion, space)
This is an antithesis which comprises, not an either-or-relationship, but it only presents two different ways of how HIV can be transmitted. Therefore it is a contradictory opp. Because it entails contact between containers (cell or virus) is belongs to <i>space</i> , and due to that it deals with the transmission of HIV it also deals with movement and hence <i>motion</i> .				
26	“the understanding of the delicate relationship between VIRUSES and HOSTS” (p. 259)	correlative/contradictory opp.	Yes	Yes (space)
This antithesis is active and constitutes both a contradictory and a correlative opposition. It is correlative because it entails the relationship host/virus, but in the context, there are also each other’s direct opposites, hence contradictory. Because the host acts as a container to the virus, it is a spatial conceptual antithesis, belonging to <i>space</i> . However, the virus is not a container to the host, and therefore one could also argue that the antithesis is non-spatial.				
27	“HIV can also help identify new RECEPTORS and LIGANDS and novel signaling pathways” (p. 259)	correlative opp.	Yes	Yes (motion)
For this antithesis, please view antithesis 5.				
28	“more information on the complex cross-talk between INNATE and ADAPTIVE immunity” (p. 259)	contradictory opp.	Yes	No

There are more ways of talking about immunity, but in this case only two different types of immunity is being discussed and therefore might appear to be the only two ones. Due to this dualism, the antithesis is a contradictory opp. It is active but not spatial.

## THE HOST DEFENSE OF INSECTS: A PARADIGM FOR INNATE IMMUNITY

Jules Hoffmann was one of the Nobel Prize laureates, having his Nobel lecture, the 7<sup>th</sup> December 2011<sup>©</sup>. He received the Nobel Prize on the discoveries concerning the activation of innate immunity (as did Beutler and Steinman).

	Antithesis	Sub-group	Active	Spatial
1 2	“They also have a strong impact on the economy: on the POSITIVE [a] side through POLLINATION [b], for instance, and on the NEGATIVE[a] side through the DESTRUCTION OF CROPS [b]” (p. 3)	a. contradictory opp. b. multiple. opp.	Yes	a. Yes (orient.) b. Yes (motion)
Antithesis [a] is a contradictory opp. consisting of an either-or-relationship that is positive/negative. It could be a gradable antithesis as well, but not in this context. However, this antithetical pair is a spatial conceptual antithesis due to that positive and negative is strongly correlated to up/down. Hence it belongs to <i>orientation</i> . [b] illustrated these positive and negatives sides, but there are of course more positive and negative sides economically, and therefore [b] is an intermediate since “pollination” and “destruction of” can be correlated to movement, it hence belongs to <i>motion</i> . Both antitheses are active.				
3	“My investigations confirmed that phagocytosis was an essential arm of grasshopper antimicrobial defences. Injections of LOW doses of microbes (we used <i>Bacillus thuringiensis</i> during the first years of the project) included a significant protection against subsequent administrations of HIGHER or even LETHAL doses” (p. 4)	contrary opp./ intermediate	Yes	Yes (orient)
This excerpt presents an active antithesis which is a contrary opp. due to its gradable pair low/high. However, the antithesis also includes an intermediate., due “lethal” beign a synonym to “higher”. Since high/low is interpreted as a vertical direction it is a spatial conceptual antithesis which belongs to <i>orientation</i> .				
4	“in the abdomens of both LARVAL and ADULT grasshoppers” (p. 4)	contradictory/ correlative opp.	Yes	No
This active antithesis is a contradictory opp. as well as a correlative one. It is correlative since it illustrates a relation (as adult/child), but it is also contradictory because in this context, they are each other’s direct opposites. It is not a spatial antithesis.				
5	“For one, grasshoppers which had their hemopoietic tissue selectively SUBJECTED TO X-RAY treatment rapidly succumbed to septicemia by opportunistic microbes; sham IRRADIATED grasshoppers did not show a similar phenotype” (p. 4)	contradictory opp.	Yes	Yes (orient., motion)
This is a contradictory opposition because it entails an either-or-relationship. Either the tissue is treated with radiation or it is not. It is active. It can be interpreted as belonging to a sensorimotor domain – partly because radiation entails movement, and partly because radiation often is illustrated and interpreted as vertical lines in space going in some kind of direction (mostly down).				
6 7	“When the X-ray treatment of the hemopoietic tissue was performed BEFORE [a] this critical period within any instar, the following moults were BLOCKED [b]; if the treatment was performed AFTER [a] the critical period, the next moults WAS NOT BLOKED [b] but subsequent moults were still SUPPRESSED [b]” (p. 4-5)	contradictory opp.	Yes	a. Yes (orient.) b. No/Yes (motion)
[a] is an active and a contradictory opp. which consists of before/after. Since it entails time and since time can be interpreted as being an abstract movement along a linear path, it belongs to <i>orientation</i> . [b] is also an active contradictory opp. consisting of the antithetical pair blocked/not blocked. However, whereas [a] belongs to <i>orientation</i> , [b] belongs to <i>motion</i> since “blocking” entails movement. That is not evident though.				
8	“as we now know that grasshoppers DO NOT RELY for their antimicrobial defences on the massive secretion of antibacterial peptides into their blood, IN CONTRATS TO	contradictory opp.	Yes	No

	FLIES” (p. 6)			
In this excerpt, the antithesis exists between grasshoppers and flies regarding one particular characteristic (in this context). Grasshoppers “do not rely for their antimicrobial defences on the massive secretion of antibacterial peptides into their blood”, which flies apparently do. It describes an either-or-relationship and hence the antithesis is a contradictory opp. It is active but it does not belong to any sensorimotor domain in this analysis.				
9 10	“the fruit fly fat body (---) produces several families of potent antibacterial peptides, with DISTINCT and sometimes OVERLAPPING [a] activity spectra against either Gram-POSITIVE or Gram-NEGATIVE bacteria [b]” (p. 7)	a. contrary opp. b. contradictory opp.	Yes	Yes (orient)
[a] is a contrary opp. that describes how distinct or how similar the activity of the peptides is (small proteins). Due to this gradable quality, it belongs to <i>orientation</i> . [b] is a contradictory opp. comprising the gram-positive/gram-negative bacteria (this categorization of bacteria is done on the premises of a structural difference in “walls” that surrounds the bacteria. [b] belongs to <i>orientation</i> as well due to the spatial conceptual antithesis up/down.				
11 12	“INNATE[a] immunity and ADAPTIVE [a] immunity in MAMMALS [b] (DROSOPHILA[b] lacks adaptive immunity)” (p. 9)	a. contradictory opp. b. intermediate	Yes	a. No/Yes (space) b. No
These antitheses are active. [a] is a contradictory opposition because it consists of the distinct oppositional pair “innate” and “adaptive”, which are contradictory since there are no more ways of discussing immunity in this context. [b] consists of “Drosophila” and “mammals” – at first glance these might be interpreted as contradictory, but mammals are a class within biological taxonomy and hence comprise many animals, no specified here. These antitheses are probably regarded as non-spatial conceptual antithesis. Meanwhile, when using the “innate” and “adaptive”, one is using them in relation to mammals as containers, because it is the mammal that contains the immune system. Therefore, even if it is not evident, [a] could be regarded as a spatial conceptual antithesis, belonging to <i>space</i> .				
13	“But then, to my utter dismay, we found that in LOSS-OF-FUNCTION mutant for <i>Dorsal</i> , the <i>Diptericin</i> gene was induced like in WILD-TYPE flies” (p. 11)	contradictory opp.	Yes	Yes (motion)
This active antithesis is a contradictory opposition which deals with a mutant (loss-of-function) and a normal (wild-type) fly. Due to that loss-of-function implicates movement, it belongs to <i>motion</i> – the fly has “lost” something.				
14	“the antibacterial peptide Diptericin was DEPENDENT on the imd gene and INDEPENDENT of the” (p. 12)	contradictory opp.	Yes	No
This is a contradictory opp. due to the direct opposites of dependent/independent. The antithesis is active but not spatial.				
15	“a FAINT BAND OF SIZE in the range of the Dorsal (or DIF) protein, and an additional one of HIGHER molecular weight” (p. 12)	contrary opp.	Yes/No	Yes (orient.)
This antithesis is a contrary opp. since it discusses how well the band on the gel can be seen. It is only active, and maybe also only antithetical, if one realized that “higher molecular weight” results in a much more distinct band. It belongs to <i>orientation</i> due to two different reasons. First and foremost, the band is illustrated as a horizontal line on the gel, secondly because “higher” is an abstract vertical direction in space.				
16	“the Drosomycin gene was PERFECTLY INDUCIBLE by immune challenge (bacterial mix) in imd mutants, but was CLEARLY NOT INDUCED in Toll pathway mutants by the same challenge” (p. 13)	contradictory opp.	Yes	Yes (motion)
This is too a contradictory opp. discussing if something is induced or if it is not. “inducing” entails movement and hence the antithesis can be categorized as <i>motion</i> .				
17	“Particularly striking were the results obtained with Cactus-deficient flies, in which the Drosomycin gene was STRONGLY EXPRESSED IN THE ABSENCE of infection, but NOT the Diptericin gene” (p. 13)	contradictory/contrary opp.	Yes	Yes (motion)
This active antithesis is a contradictory opp. that illustrates how well two different genes are being expressed (replicated form DNA in order to have some kind of effect). Due to this dichotomy, it is hence contradictory. Since Hoffmann also describes how well the <i>Drosomycin</i> gene is expressed – “strongly” – the antithesis is also a contrary opp. since how strong or how well a gene is being expressed is gradable. Due to this gradability, it belongs to <i>orientation</i> . Meanwhile, it also belongs to <i>motion</i> since “expressing” is movement within the cell.				

18	“The Toll transmembrane receptor (---) contains an EXTRACELLULAR leucine-rich repeat domain, evocative of that of the LPS-binding protein CD14 (---). Its INTRACYTOPLASMATIC domain” (p. 15)	contradictory/contrary opp.	No	Yes (space, orient.)
The antithesis stated here, is non-active and comprise 1) a contradictory and 2) a contrary opposition because it describes 1) if something is outside of the cell (“extracellular”) or inside it (intracytoplasmatic); and 2) because even though this antithesis seems to portray a dichotomous relation, different molecular structures can be found in between, such as “transmembrane” structures (see xx). Because these notions express where something is according to the cell, the antithesis belongs to <i>space</i> and because it is contrary due to its gradability (on a linear scale) it also belongs to <i>orientation</i> .				
19	“a proteolytic cascade leads to the cleavage of Spätzle in the blood of adult flies and can activate Toll. This cascade is DIFFERENT FROM that which cleaves Spätzle during embryogenesis” (p. 15-16)	contradictory/contrary opp.	No	No/Yes (orient.)
This is a non-active, non-spatial antithesis which is a contradictory opp. since it describes how different two mechanisms (cascades) are in two different states. Meanwhile, since “difference” is gradable, this antithesis is also a contrary opp. Regarding this gradability, the antithesis could be interpreted as belonging to <i>orientation</i> but this might not be so evident.				
20 21 22	“the IMD PATHWAY [a] is strongly induced by GRAM-NEGATIVE bacteria and GRAM-POSITIVE BACILLI [b] (which contain a peptidoglycan in their envelope which is DISTINCT FROM that of other GRAM-POSITIVE BACTERIA [b], see below). In contrast, the TOLL PATHWAY [a] is stimulated preferentially by FUNGI and GRAM-POSITIVE BACTERIA [c], and to a lesser extent by GRAM-NEGATIVE BACTERIA [c]” (p. 16)	a. contradictory opp. b,c. contradictory opp./ intermediates	Yes	a. No/yes (orient.) b,c (orient.)
[a] is a contradictory opp., consisting of two different pathways which are the only ones in this excerpt, and in the context. It can be interpreted as belonging to <i>orientation</i> since a pathway is some kind of direction. [b] is a contradictory opp. in the sense that two groups are being compared which are each other’s opposites, “gram-negative bacteria and gram-positive-bacilli” and “gram-positive bacteria” (bacilli is a taxonomic class of bacteria, which is why these two groups can be each other’s opposites). Meanwhile, since one of the antitheses includes more than one group, it is also an intermediate Due to that the different bacteria are being referred to as “positive” or “negative” this could make them belong to <i>orientation</i> . However, if one knows what it mean – the bacteria being either negative or positive – one might not interpret it as something that deals with orientation in space. The same reasoning applies for [c], but here fungi are a part of the group and gram-negative bacteria is the one being alone.				
23	“trigger the Toll pathway by activating an UPSTREAM proteolytic cascade upon recognition by PGRPs or GNBPs respectively.” (p. 18)	contradictory/contrary opp.	No	Yes (orient.)
This non-active antithesis, a contradictory and contrary opposition, describes where a gene is on DNA for instance, or where a molecular mechanism is taking place on DNA. One uses the antithesis “upstream” (in front of, depending on the orientation of DNA) and (here implicit) “downstream” (behind) in order to orient oneself on DNA. In this case, a mechanism is taking place in front of a specific site on DNA. Because of this abstract linear DNA, as well on the fact that up/down can be put on a gradable, linear scale, the antithesis belongs to <i>orientation</i> .				
24	“Tolls are typically associations between EXTRACELLULAR leucine-rich recognition/interaction domains and INTRACELLULAR TIR domains which often” (p. 23)	contradictory opp.	Yes	Yes (space, orient.)
The same reasoning applies here as did for excerpt 18. However, this is only a contradictory opp.				
25	“Significant progress has been made recently in this field and it is now understood that the IMD, and NOT the Toll, pathway mediates the induction of antimicrobial peptide expression in epithelia” (p. 24)	contradictory opp.	Yes	No
This is an active antithesis (IMD and Toll pathway) which is a contradictory opp. emphasizing what is “not” understood in comparison to before. It is not a spatial conceptual antithesis.				
26	The IMD pathway (and probably also the Toll pathway) are activated by endogenous LIGANDS. Our	correlative opp.	Yes	Yes (motion,



	information on the endogenous inducers and their RECEPTORS is almost non-existent” (p. 24)			orient.)
This active antithesis is a correlative opp. due to the relationship between the ligand and the receptor. Since these two involves movement and in different directions to one another, they belong to both <i>motion</i> and <i>orientation</i> .				

## HOW MAMMALS SENSE INFECTION: FROM EDOTOXIN TO THE TOLL-LIKE RECEPTORS

This lecture was presented by Bruce Beutler, 7<sup>th</sup> December 2011<sup>©</sup>, and deals with how mammals are able to detect an infection by means of activation of the innate immunity.

	Antithesis	Sub-group	Active	Spatial
1	“the battle between HOST and MICROBE” (p. 4)	correlative opp.	Yes	Yes (space)
This active antithesis is correlative because it describes a relationship between the HOST and the MICROBE. Because the host is a container to the microbe it hence belongs to <i>space</i> .				
2	“Pfeiffer noted that guinea pigs died when injected with a large inoculum of <i>V. cholerae</i> , even if PASSIVELY or ACTIVELY immunized against the microbe” (p. 4)	contradictory opp.	Yes	Yes (motion)
This antithesis depicts an active contradictory opp. (an either-or-relationship) than also implies a movement and hence belongs to <i>motion</i> .				
3	“With the passage of decades it was understood that endotoxin was, CHEMICALLY speaking, a lipopolysaccharide (LPS)” (p. 5)	intermediate	No	No
By saying “CHEMICALLY speaking” one implies that there are other ways of approaching the endotoxin (a toxic substrate), and therefore this antithesis is an intermediate. It is however not active, since no other ways of approach the substrate is given, and it does not belong to any sensorimotor domain.				
4 5 6	“Of importance to our work later on, it was noted that some LPS partial structures are AGONISTIC [a] when applied to MOUSE CELLS [b], but ANTAGONIZE[a] LPS when applied to HUMAN CELLS [b]. The best example of this was Lipid IVa, which LACKED acyl-oxyacyl side chains, and HAD ONLY four lipid chains [c]” (p. 5)	a,c. contradictory opp. b. intermediate/contradictory opp.	a,b. Yes c. No	a. No b. Yes (space) c. No/Yes (orient.)
The antitheses [a] and [b] are active, whereas c is not. [a] is a contradictory opp. since the antithetical elements comprising the pair are each other direct opposites. [b] is an intermediate since there are not only mouse cells and human cells but of course many other. However, in this context, the different cell groups could be interpreted as a contradictory opp. as well since in this case, it only deals with these two different species. c is a contradictory opp. telling us how Lipid Iva differs from other Lipids in this context. None of these antitheses are spatial conceptual antitheses.				
7	“and was also known to induce both the LOCAL and GENERALIZED Shwartzman reactions” (p. 5)	contradictory opp.	Yes	No
This antithesis is active and comprises a contradictory opp. since it describes the two different ways of viewing the Shwartzman reaction – either locally or generally.				
8	“As a class, mammals are MORE REACTIVE to LPS than other vertebrates” (p. 5-6)	contrary opp.	Yes	Yes (orient.)
The word “more” implicates that the antithesis belongs among the contrary oppositions, and hence <i>orientation</i> .				
9	“And much was known about the general characteristics of the receptor: that it COULD DETECT many structural variants of LPS, for example, but was NOT INVOLVED in the PERCEPTION of other inflammatory molecules made by microbes” (p. 6)	intermediate	Yes	Yes (motion)
This antithesis deals with intermediate since it describes in what mechanisms the receptor is involved, but also where it is not involved. However, it does not say specifically where it is involved, and hence implies many different probabilities – therefore it is an intermediate Since “detection” and “involvement” concerns some kind of movement, the antithesis belongs to <i>motion</i> .				
10 11 12	“If the HOST [a] remains IGNORANT [b]of the infection, CONTAINMENT DOES NOT OCCUR [c]; hence the burden of MICROBES [a] becomes much	a. correlative opp. b. contradictory opp. c. contradictory/contrary	Yes	a. Yes (Space) b. No

	greater. By the time the microbes ARE DETECTED [b] because of other molecules they produce (---), it is TOO LATE TO CONTAIN [c] the infection, and the host is overwhelmed” (p. 7)	opp.		c. Yes (motion, orient.)
All antitheses in the excerpt above are active. [a] is a correlative opposition since it presents a relation between the host and the microbe infecting the host. Because the host is a “container” to the microbe, the antithesis belongs to <i>space</i> . Both [b] and [c] are contradictory oppositions since: [b] entails the host to be ignorant/not ignorant (“by the time the microbes are detected – hence not ignored”); [c] consists of that the body realizes the infection and can fight them (“containment does not occur”)/the body has not realized them and therefore cannot fight them (“is too late to contain”). Both [b] and [c] are not contradictory lexically, but implicitly. [b] describes a state of mind and is therefore not spatial. [c] is spatial and belongs to both <i>motion</i> and <i>orient</i> . because it partly describes a movement (the containment) as well as a period of time, and because time can be interpreted as an abstract linear path, where the immune system is either on time or is too late in order to save the body, it hence belongs to <i>orientation</i> . From this perspective, [c] can also be a contrary opposition.				
13	“But it was not possible to obtain the amino acid sequence of the protein, which evidently became N-TERMINAL modified in the course of purification” (p. 9)	contradictory opp.	No	Yes (orient.)
Due to that the C-terminal (the “ends” of an amino acid) is not mentioned in relation to the N-terminal, the antithesis is not active. It is contradictory (because of the direct opposites, N- and C-terminals) and since it depicts a structure in line with two ends, it hence belongs to <i>orientation</i> .				
14 15	“This factor was also capable of killing TUMOR CELLS, but not NORMAL CELLS [a], IN VITRO [b]” (p. 10)	a. intermediate b. contradictory opp.	a. Yes b. No	a. No b. Yes (space)
[a] is an active antithesis, consisting of “tumor” and “normal cells”. Because “normal cells” is an umbrella term it does include many other cells – therefore, this antithesis is an intermediate. However, in this particular context, it can be regarded as a contradictory opp. It deals not with any spatial relations (at least not regarding what fits the framework of this thesis). The other antithesis however, [b], is not an active one since its opposite (hence contradictory), “in vivo” (within a living body), is not parallel to it in text. As to whether this antithesis is spatial or not is a difficult question. If “something”, whatever that something is, is “in” something else, it does belong to <i>space</i> (which is a sensorimotor domain that entails “containers”, different limited areas in space, and how things related to the container”).				
16	“indicating that TNF was one of the MAJOR factors responsible for endotoxicity, though NOT the SOLE factor” (p. 10)	contrary opp., intermediate	Yes/No	No/Yes (orient.)
This antithesis is both active and non-active. It is active as an intermediate because it is being described that TNF is a major factor, but that it is not the only one – hence the word “sole” allows for many other factors even though these other sole factors are not defined. In this sense, the antithesis is not a spatial conceptual antithesis. The antithesis can also be contrary because the opposite antithetical pair to major is minor, which can be put on a linear scale, and hence this pair is gradable and therefore contrary (and belongs to <i>orientation</i> ). Meanwhile, the “minor” is never active, and therefore this antithesis is not active.				
17	“TNF RECEPTORS (---) were found to exist on many cells throughout the body; and to trigger inflammatory responses when exposed to the LIGAND” (p. 12)	correlative opp.	Yes	Yes (motion, space)
This active antithesis is a correlative opp. Which depicts the relation between the receptor (a molecule that, when binding to a ligand, performs some kind of mechanism/process) and its ligand (what binds to the receptor in order to activate it). Because these “exist on” cells respectively “bind to” they both belong to <i>space</i> . They also belong to <i>motion</i> because they illustrate a molecular movement.				
18	“to show that LPS INDUCED cachectin activity and DID NOT ITSELF POSSESS this activity when applied to adipocytes” (p. 13)	contradictory opp.	Yes	Yes (motion)
This antithesis is of a contradictory oppositional-character because it describes what a molecular structure (LPS) does do (induce cachectin activity) but simultaneously describes what it does not do (did not itself possess this activity). Because it describes a movement, it belongs to <i>motion</i> .				
19	“Ulevitch lab subsequently showed that overexpression of CD14 in 70Z/3 pre-B cells would greatly ENHANCE LPS RESPONSIVENESS in these	contradictory opp.	Yes	Yes (motion)

	cells, which were OTHERWISE MINIMALLY RESPONSIVE TO LPS” (p. 14)			
This is a contradictory opp. describing a normal as well as an abnormal behavior in pre-B cells in terms of “responsiveness”. Because of the choice of word “responsiveness”, it does indeed belong to <i>motion</i> .				
20	“these regulatory mechanisms permitted a several thousand-fold increase in TNF secretion by ACTIVATED cells as compared to QUIESCENT cells” (p. 15)	contradictory opp.	Yes	Yes (motion)
What is being describes here is whether the cells are activated or not, and hence his is an active contradictory opposition which belongs to <i>motion</i> because of the movement that the expressions “activated” and “quiescent” cells entail.				
21 22 23	“The effort WAS NOT ENTIERLY STRAIGHT FORWARD [a], because the mutation was SEMI-DOMINANT [b] and some PHENOTYPIC assignments were AMBIGUOUS [c]” (p. 17)	a. contrary opp. b,c. contrary opp./ intermediate	No	Yes (orient.)
The antitheses here are non-active. The first one, [a], is not a biological expression, however it is still an expression that do tell us something about the biological mechanism. By saying it is not straight forward (straight forward comprises a direction, and hence <i>orientation</i> ) means that there is a gradability to it, thereby the antithesis is contrary. Antithesis [b] describes how dominant the influence of a mutation in DNA is, and there are many options when describing how a mutation influences the cell (or the individual) – therefore it belongs to intermediate. Meanwhile, because it describes <i>how</i> dominant the mutation is, it is also a contrary opp. The same reasoning goes for [c], since it too describes the influence of a mutation, but it describes the phenotype (the physical influence of the mutation) .				
24 25	“We now know that the total gene number was overestimated four-fold, and that the <i>Lps</i> critical region is rather POOR [a] in GENES [b], though RICH [a] in PSEUDOGENES [b]” (p. 17)	a. contrary opp. b. contradictory opp.	Yes	a. Yes (orient.) b. No/Yes (orient.)
Antithesis [a] is active and consists of the contrary pair “poor” and “rich”, a gradable antithesis. Due to its gradability, and because it probably is interpreted as a linear scale it belongs to <i>orientation</i> . Antithesis b) is a contradictory opp. which consists of the direct opposites, genes (coding for functional proteins) and pseudogenes (no longer code for functional proteins). At first glance, [b] is probably not interpreted as a spatial conceptual antithesis, however, a gene could be interpreted as a linear structure in space, and therefore it could belong to <i>orientation</i> .				
26	“The contig had, at first, ‘islands’ of BACs SEPARATED FROM each other until they could BE JOINED by chromosome walking” (p. 18)	reverse contrary opp.	Yes	Yes (motion, orient.)
This active antithesis is a reverse contrary opp. depicting a reversible movement of chromosomes. Because chromosomes are illustrated as linear structures and because their movement is being describes a either separated or joined, the antithesis belongs both to <i>orientation</i> and <i>motion</i> .				
27 28	“Exon trapping, which soon went out of fashion, depended on cloning BAC DNA into special vectors with DONOR and ACCEPTOR [a] splice sites. If a piece of DNA happened to have an exon IN IT, the exon would BE SPLICED when [b]” (p.19)	a. contradictory/ correlative opp. b. contradictory opp.	Yes	a. Yes (motion, space) b. Yes (motion)
[a] is an active antithesis, being both a contradictory as well as a correlative opp. due to its antithesis, acceptor and donor. These biological expressions depict a relation (correlative opp.) which is the only possible relation (contradictory opp.) in this context. However, in reverse contrary mechanisms, a molecular structure could be both a donor and an acceptor. Because these notions entail movement between two structures, it belongs to <i>motion</i> and <i>space</i> . Antithesis [b] however, is an active contradictory opposition due to that it comprises when something is a part of DNA (IN IT), and when it does not (BE SPLICED). Since it entails movement, it belongs to <i>motion</i> .				
29	“the modified TLR4 construct would cause UPREGULATION of costimulatory molecules” (p. 23)	contradictory/contrary opp.	No	Yes (motion, orient.)
This is a non-active antithesis, describing how TLR4 (toll-like receptor), affects the amount of molecules. By saying that something is going “up”, there is an implicit comparison that it also could be going down, and hence				

it is a contrary opp. Meanwhile, because it is either going up or down, it can also be interpreted as a contradictory opp. Because the expression entails a vertical direction, it belongs to <i>orientation</i> , and because it illustrates a movement, it belongs to <i>motion</i> .				
30 31	“A 74 kb interval of genomic DNA was cleanly excised, REMOVING [a] <i>Tlr4</i> [b] but SPARING[a] ALL OTHER GENES [b]” (p. 24)	a. contradictory opp. b. contradictory opp./intermediate	Yes	a. Yes (motion) b. No
Antithesis [a] is active and consists of removing/sparing – and either-or-relationship, and is therefore a contradictory opposition. Because of the movement, implied in the expression, it belongs to <i>motion</i> . [b] however, does not belong to any sensorimotor domain. In this antithesis, active however, consist of the gene <i>Tlr4</i> and “all other genes”, where “all other genes” could be any other gene (obviously) and therefore it is an intermediate. Meanwhile, in this context, the antithesis could also be interpreted as a contradictory opposition.				
32 33	“certain LPS partial structures, notably Lipid Iva, ANTAGONIZE [a] LPS when it is applied to HUMAN [b] mononuclear cells, but act as AGONISTS [a] in THE MOUSE [b]” (p. 26)	a. contradictory/ correlative/ reverse contrary opp. b. intermediate	Yes	No
Both antitheses are active but not spatial. [a] is contradictory, reverse contrary and correlative: it describes how certain structures of LPS can act as both (hence reverse contrary and correlative) agonists and antagonists (which illustrates oppositional actions, hence contradictory) depending on species. [b] is reasoned about as b) in the excerpt above.				
34	“Lipid IVA differed from Lipid A only by the ABSENCE of two acyl side chains in the former [human cells] and their PRESENCE in the latter [mouse cells]. We hypothesized that TLR4 itself would ‘decide’ whether those chains were PRESENT or ABSENT” (p. 26)	contradictory opp.	Yes	Yes (space)
This antithesis comprises an active contradictory opposition by the same antithetical pair, namely absence/presence. It is not a reverse contrary opp. because the absence and presence of acyl chains (a molecular structure which looks like a chain) are restricted to two different molecular structures (Lipid Iva and Lipid A). Because absence and presence deals with whether an entity is there or is not there, in space, in hence belongs to <i>space</i> .				
35 36	“In cells expressing MOUSE [a] TLR4, BOTH[b] Lipid A and Lipid Iva could induce TNF production. In cells expressing HUMAN TLR4, ONLY Lipid A, BUT NOT [b] Lipid Iva, could induce TNF production” (p. 26)	a. intermediate b. contradictory opp.	Yes	a. No b. No/Yes (motion)
In this excerpt, both antitheses are active and neither is spatial. [a] is reasoned about as in [b] in the excerpt above. [b] however is a contradictory opposition. First it tells us that both lipids induce the production of toll-like receptors, whereas in humans cells (the opposite to mouse cells) only one of the lipids is doing that. Regarding the spatiality of [b], if one includes the movement “induce” implicates as an expression, it could belong to <i>motion</i> .				
37	“we estimated that only A FEW hundred receptors exist per cell. Yet these cells RESPOND VIGOROUSLY to LPS, consistent with strong signal amplification” (p. 27)	contradictory/contrary opp.	Yes	Yes (motion, orient.)
This is an (active) antithesis in the sense that by saying “a few receptors” one allows for the assumption that a few receptors only allow the cells to respond a little. Therefore the expression “respond vigorously” will probably be interpreted as a contrast, because it implies the opposite consequence of what was expected by saying “a few”. It is contradictory due to the strong opposite. Meanwhile, because the amount of receptors is gradable, as is how “well”/”much” a cell can respond, it is also a contrary opp. Since it entails movement (respond) is can thus be categorized as <i>motion</i> , but <i>orientation</i> as well due to that “a few” entails numbers, which can be interpreted as a numbered scale (horizontal direction).				
38	“I calculated that the dramatic shock syndrome and LETHAL EFFECT of LPS are delivered by only A FEW NANOGRAMS of TLR4 protein in the mouse” (p. 27)	contrary opp.	Yes	Yes (orient.)
This antithesis deals with the same antithesis as does the one above.				
39	“X-ray crystallography has now shown that different ligands bind their respective TLRs in STRIKINGLY DIFFERENT WAYS. Some do so in	contradictory opp.	Yes	Yes (motion)

	conjunction with helper proteins, or co-receptors, as discussed below. In ALL INSTANCES, signaling is mediated by the recruitment of adaptor proteins, with structural SIMILARITY to the CYTOPLASMATIC domains of the TLRs themselves” (p. 28-29)			
This active antithesis describes how the different ligands bind to their TLRs in different ways, but it also deals with how these very different ligands are alike (“all instances”). Because it deals with differences as well as similarities it is a contradictory opp. Since it deals with a movement, it belongs to <i>motion</i> .				
40 41	“This protein DOES NOT signal BY WAY [a] of a TIR [b] motif, but BY WAY [a] of a NON-RD KINASE [b] motif” (p. 30)	contradictory opp.	Yes	No
Antithesis [a] is a non-spatial contradictory opp. describing how something is and how something is not. In relation to the two different “motifs”, it is active. [b] is a contradictory opp. Too due to that the motifs being described here are each other direct oppositions in this context. They are active but not spatial.				
42	“This screen probes both T-DEPENDENT and T-INDEPENDENT immunization” (p. 36)	contradictory opp.	Yes	No
This active antithesis is of course contradictory, due to the direct opposites (independent/dependent). It cannot be correlated to the spatial sensorimotor domains in this thesis.				

## THE PRINCIPLE OF MEMBRANE FUSION IN THE CELL

This Nobel lecture, held 7<sup>th</sup> December 2013<sup>©</sup> by James Edward Rothman concerns the discovery of the machinery that regulates vesicle traffic (transporting membrane-coated “bubbles” that contains important information, material etc.) which is of major importance – both within and between cells.

	Antithesis	Sub-group	Active	Spatial
1	“or transport vesicles, that BUD from one membrane and FUSE with the next” (p. 201)	reverse contrary opp.	Yes	Yes (motion)
This active antithesis is a reverse contrary opposition, because “bud” and “fuse” comprise a reversible mechanisms within and in-between cells. Because this antithetical pair comprises movement, it belongs to <i>motion</i> . Moreover, as has to be mentioned here, this is correlated to “the binding-release-cycle”, which is of a reverse contrary, active character as well and actually constitutes a biological expression.				
2 3	“The result is a choreographed program of SECRETORY [a], biosynthetic and ENDOCYTIC [a] protein traffic that serves the cell’s INTERNAL [b] physiologic needs, propagates its internal organization and allows it to communicate with the OUTSIDE WORLD [b] and to receive nutrients and signals from it” (p. 201)	contradictory opp.	Yes	a. Yes (motion) b. Yes (space, orient.)
Antithesis [a] is a contradictory opp. comprising “secretory” (sending something out) and “endocytic” (taking something in”. Since this entails movement, it belongs to <i>motion</i> . [b] is too a contradictory opp. due to the direct opposites “internal” (inside) and “outside world” (outside). Due to that Rothman describes what is happening Inside of and OUTside of the cell, it belongs to <i>space</i> but also <i>orientation</i> since outside/inside can be interpreted as a gradability, hence a linear, abstract scale, hence orientation.				
4 5 6 7	“BUDDING [a] (when the vesicle PINCHES OFF [b] from a ‘DONOR’ [c] membrane) and FUSION [a] (when the membrane of the vesicle MERGES [b] with the ‘ACCEPTOR’ [c] membrane of the intended target). The membrane fusion process has special importance for both INTRACELLULAR [d] and EXTRACELLULAR [d] physiology” (p. 201)	a,b. reverse contrary opp. c. contradictory/correlative opp. d. contradictory opp.	Yes	a,b. Yes (motion) c. No/Yes (motion) d. Yes (space)
All of the following antitheses are active. [a] and [b] comprise the reverse contrary opposition budding/fusion				

<p>(see excerpt (10)) and pinches off/merges (which are synonymous antithesis). Because these can be interpreted as movements, both belong to <i>motion</i>. [c] is both a contradictory and a correlative opposition because it entails an exact oppositional relation between two entities. On the one hand [c] is not spatial, but on the other hand – if approached from another perspective – it is since a donor or an acceptor is receiving something or is giving something away which is an act, a movement, hence <i>motion</i>. It is however implicit. [d] is a contradictory opposition, intracellular/extracellular, and describes whether something is in the cell or outside of it. Because it describes a relation in space, it hence belongs to <i>space</i> and is therefore a spatial conceptual antithesis.</p>				
8 9 10	<p>“oligosaccharide processing entails the INITIAL [a] ADDITION OF [b] a PRECURSOR [c] oligosaccharide to the protein in the ER, followed by the SEQUENTIAL [a] REMOVAL OF [b] certain glucose and mannose residues, and then the addition of the “TERMINAL” [c] sugar” (p. 211)</p>	<p>a. contradictory opp./ intermediate b. contradictory opp. c. contrary opp.</p>	Yes	<p>a,c. Yes (orient.) b. Yes (motion)</p>
<p>The active antithesis [a] is both a intermediate as well as a contradictory opp. It consists of initial/sequential, describing time. It could be seen as a dichotomous antithesis, hence contradictory opp., however the “sequential” is unspecified and allows for many interpretations, therefore it does also comprise a intermediate (however it would not be constructive to specify the time here). Since it describes time, and since time is generally interpreted as something moving along a linear path, the antithesis belongs to <i>orientation</i>. [b] (active) is a contradictory opp. describing the “addition of” as well as the “removal of” different types of sugar molecules. Is it not a reverse contrary opp. as well? It might be interpreted as that but due to that these two different, otherwise reversible mechanisms, deals with different sugar molecules. Because it entails movement, it belongs to <i>motion</i>. [c] (active) is a contrary opp. comprising “precursor” and “terminal” – what came first and what came last. Since it both describes a linear structure in space as well as time, it belongs to <i>orientation</i>.</p>				
11 12	<p>“two bands are observed: the PARENT [a] band (<math>G_R</math>, RESISTANT [b] to Endo H) and the SHIFTED [a] band (<math>G_S</math>, SENSITIVE [b] to Endo H) (p. 213)</p>	<p>a. correlative opp. b. contradictory opp.</p>	Yes	<p>a. No/Yes (motion, orient.) b. Yes (motion)</p>
<p>Antithesis [a] is a correlative opp. due to the relationship between the “parent band” and the “shifted” one. Since it illustrates how these “bands” have travelled on a gel (a method for separating proteins, DNA; RNA and such) it could belong to <i>motion</i> and <i>orient</i>. but then one is expected to be familiar with this method. [b] on the other hand is a contradictory opp. due to sensitive/resistant. One might believe that is a contrary opp. as well. However – in this context – the protein travelling in the gel is either sensitive <i>or</i> resistant. Therefore it is not a contrary opp. Since it illustrates some kind of movement, it belongs to <i>motion</i>. Both are active.</p>				
13	<p>“and determined whether any of the Endo H-SENSITIVE G protein present at the outset of the cell free incubation in the ER had become Endo H-RESISTANT (which would indicate transport from the ER to the Golgi)” (p. 213)</p>	contradictory opp.	Yes	Yes (motion)
<p>For this antithesis, please see above, antithesis 12.</p>				
14 15 16	<p>“one (the “DONOR” [a]) produced from VSV-INFECTED [b]15B MUTANT cells [c], and the other (the “ACCEPTOR”) produced from UNINFECTED [b] WILD-TYPE cells [c]” (p. 214)</p>	<p>a. contradictory/ correlative opp. b,c. contradictory opp.</p>	Yes	<p>a. Yes (motion) b,c. No</p>
<p>[a] is a contradictory opp. as well as a correlative one. It is correlative because of the relationship between a donor and an acceptor – something is being given, and something is received in turn. Also, these two are each other’s opposites. [b] and [c] are contradictory opp. due to that both (active) antitheses are depicting direct opposites. [b] consists of infected/uninfected and [c] (even though not so evident to anyone) consists of mutant/wild-type, where the mutant cells are cells which have transformed DNA and the wild-type are “natural”. Because [a] deals with a relationship where something is being given, it could be interpreted as movement, and hence belongs to <i>motion</i>. [b] and [c] are not spatial.</p>				
17 18	<p>“For example, if vesicles carrying the <math>G_S</math> protein were to BUD OFF [a] from DONOR [b] ER membranes and FUSE [a] with the Golgi membranes from the ACCEPTOR [b] homogenate, then the transported <math>G_S</math> would be converted to <math>G_R</math>” (p. 214)</p>	<p>a. reverse contrary opp. b. contradictory opp.</p>	Yes	Yes (motion)
<p>Antithesis [a], please see 1. For [b], please see 12.</p>				

19	“IN VITRO labeling conditions (...) The first successful IN VIVO labeling conditions” (p. 214)	contradictory opp.	Yes	No
This active antithesis is a contradictory opp. due to that it illustrates a dichotomy in vitro/in vivo, where in vitro means “synthetically” and in vivo means “in real life”.				
20	“involved a short “PULSE”-LABEL [a,b] with <sup>35</sup> S-methionine followed by a 20-minute period of “CHASE” [a] with UNLABELED [b] methionine” (p. 215)	contradictory opp.	Yes	a. No b. Yes (motion, orient.)
These active antitheses are probably contradictory opp. due to that they present two different substrates – being either labeled or unlabeled. The “pulse” and “chase” are different steps of conducting a method (on a gel), where the pulsing involves exposing the cells to the labeled compound, and then afterwards (the chasing), exposing the cells to the same compound, but this time unlabeled. Because b) involves some kind of movement, it belongs to <i>motion</i> , and since “chase” implies “following after” (which is directional), it also belongs to <i>orientation</i> .				
21 22 23	“This implied that the DONOR [a] is the Golgi [b] – NOT [b] the ER or its transitional elements. Since the ACCEPTOR [a] is also a Golgi membrane, it followed that transport between two Golgi stacks, one from the 15B cells [c] and the other from the WILD-TYPE cells [c], had been reconstituted” (p. 216)	a. correlative/ contradictory opp. b,c. contradictory opp.	Yes	a. Yes (motion) b,c. No
For antithesis [a], please see previous examples involving the same antithesis. [b] is a contradictory opp. since it explains what is and what is not. [c] is contradictory in the sense that it involves the “mutant” or different cells as well as the wild-type, i.e. the “normal” cell. Since these are the only ones in this context, they are contradictory. All are active, and only [a] is spatial.				
24 25 26 27	“GTP-BOUND [a] ARF RECRUITS [b] the coatomer to the GOLGI (triggering COAT ASSEMBLY [d] and vesicle budding), and RELEASES [b] it back to the CYTOSOL [c] after it HYDROLYZES the GTP [a] (UNCOATING) [d]” (p. 219)	a. contradictory/ reverse contrary opp. b,c,d. reverse contrary opp.	a,b,d. Yes c. No	Yes (motion)
Antithesis [a] is both contradictory and reverse contrary. It is contradictory in the sense that it illustrated how the substrate ARF is first GTP-bound and then it becomes hydrolyzed, which mean that the GTP is being released. This might however only be clear to a biologist. It is a reverse contrary opp. since it illustrated a reversible mechanism. The other three antitheses are reverse contrary opposites: [b] consisting of recruit/release; [c] “back to the cytosol” (implying that is has been there before); and [d] COATING/UNCOATING. All are active but [c]. All them entail movement, and hence all of them belong to <i>motion</i> .				
28	“ARF is charged with GTP at the GOLGI SURFACE, ‘switching on’ budding by recruiting coatomer from the CYTOSOL” (p. 221)	contradictory/contrary opp.	Yes	Yes (space, motion, orient.)
This antithesis deals with a contradictory opposition, but from another perspective it is also a contrary one. It is contradictory in the sense that there are only two different cellular compartments present in the example, and therefore a contradictory opposition is being constructed. It is contrary in the sense that it involves some kind of directional movement between the Golgi and the cytosol (the cytosol is liquid in the cell, surrounding all the cell’s organs, and the Golgi is such an organ). Due to these different compartments, the motion related to them as well as the movement being directional, makes the antithesis belonging to <i>space</i> , <i>motion</i> and <i>orientation</i> .				
29	“How, then, does SNAP – which is also a cytosolic protein – bind to membranes? SNAP binds to one or more saturable, high affinity “SNAP RECEPTORS” (“which we termed <i>SNARES</i> ”)” (p. 223)	correlative opp.	No/Yes	Yes (motion)
The antithesis above is active if one realizes that the SNAP is a ligand to the SNAP receptor. It is the ligand/receptor that comprises the antithesis, illustrating a correlative opposition due to the relationship between them. It could be compared with the correlative opp. between donor/acceptor. Because the ligand <i>binds</i> to the receptor, the antithesis belongs to <i>motion</i> .				
30	“key proteins in the key proteins in the mitochondrial OUTER membrane needed for protein import” (p. 224)	contradictory opp.	No	Yes (space, orient.)
This antithesis is a non-active contradictory opposition, which does only present one antithesis, namely the “outer membrane ”of the mitochondrial membrane. The mitochondrion is one of the cell’s organs which turns food into cellular energy. This organ does not only have an outer membrane, but also an inner one, implicated when stating that the key proteins are situated in the outer membrane. Because the inner is not presented, the				



antithesis is non-active. It is not contrary because either it concerns the outer membrane or the inner one. Because the antithesis concerns a place, it belongs to <i>space</i> , and since it also concerns some kind of direction, it belongs to <i>orientation</i> as well.				
31	“the BINDING-RELEASE-cycle” (p. 224)	reverse contrary opp.	Yes	Yes (motion)
This is obviously a reverse contrary, active opp. which is also a biological expression. It involves movement, and therefore belongs to <i>motion</i> .				
32 33	“The ASSEMBLY and DISASSEMBLY [a] of 20S particles, involving BINDING and RELEASE [b]of NSF from SNAP” (p. 225)	a. contradictory/ reverse contrary opp. b. reverse contrary opp.	Yes	Yes (motion)
Both antitheses in the excerpt are active, and since both involve movement, they both belong to <i>motion</i> . [a] is a contradictory opp. due to that they comprise the negation of one of the antitheses: assembly/disassembly. Since it also involves a reversible mechanism, it is also a reverse contrary opp. For antithesis [b], see above.				
34	“each [protein] PRESENT [a] in the SPECIFIC (MgATP) [b] eluate and ABSENT [a] from the NON-SPECIFIC (MgATP $\gamma$ S) [b] eluate” (p. 226)	contradictory opp.	Yes	a. Yes (space) b. No
[a] is a contradictory opp., as is [b]. Both illustrate cases, when compared, illustrates an either-or-relationship in a dichotomous sense. Either the proteins are “present” in the “specific” eluate or they are “absent” in the “non-specific” eluate. Neither is spatial, but both are active.				
35	“physiology (ENDOCRINE and EXOCRINE secretion)” (p. 229)	contradictory/ reverse contrary opp.	Yes	Yes (motion)
This antithesis is both contradictory (as it depicts two mechanisms which are each other’s direct opposites – the “endo” involving some kind of “fusing”, and the “exo”, involving some kind of “budding” or such). It is reverse contrary due to what is being secreted is also being absorbed elsewhere. It involves movement, and therefore belongs to <i>motion</i> .				
36 37	“Thus, when complementary v-SNARE and t-SNARE [a]pairs engage, a productive fusion event is not only INITIATED – as we had first imagined – but it is also COMPLETED [b]” (p. 229)	a. correlative opp. b. contradictory opp.	Yes	a. No b. Yes (motion orient.)
The pair in [a] are complementary and are therefore illustrating a relationship, and hence depicts a correlative opp. It is active but not spatial. [b] involves movement as well as time (which could be interpreted as something moving along a linear path – horizontal direction) and therefore belongs to <i>motion</i> and <i>orientation</i> . Because it is consisting of a start in terms of “initiated”, as well as a stop in terms of “completed” – a pair which is a direct opposite – it hence is a contradictory opp.				
38	“a SNARE complex is literally PULLED APART and the[n] allowed to ZIPPER BACK UP again” (p. 232)	reverse contrary opp.	Yes	Yes (motion, orient.)
This is a reverse contrary mechanism, an active antithesis comprising “pulled apart” and “zippered back up”. Because it involves movement in a vertical direction it belongs to both <i>motion</i> and <i>orientation</i> .				

## THE WINDING ROAD TO PLURIPOTENCY

Shinya Yamanaka held his Nobel lecture, 7<sup>th</sup> December 2012<sup>©</sup>, which deals with the discovery that mature cells (cells that have received a definite cell type and which are not changing into another cell type) can be reprogrammed to become so called pluripotent – i.e. the ability to develop and become more than one cell type.

	Antithesis	Sub-group	Active	Spatial
1 2	"No drug can be 100% SPECIFIC [a] or EFFECTIVE [b], so there are ALWAYS NON-SPECIFIC [a] activities or INCOMPLETE BLOCKADE [b] of the targets" (p. 266)	a. contradictory /contrary opp. b. contrary opp.	Yes	a. Yes (orient.) b. Yes (motion, orient.)
Both these antitheses are active. One the one hand [a] is a contradictory opp. because it comprises 100% specific/always non-specific – antithesis which are each other exact opposites. On the other hand [a] is a contrary opposition because how specific the drug is can be places on an abstract linear scale, it is hence gradable, and therefore contrary. [b] is a contrary opposition since it consists of the antithesis (100%) effective/incomplete blockade., and describes how effective a drug is, and is therefore gradable just like [a]. Consequently it can be put on linear scale, and is thereby contrary. [a] is a spatial conceptual antithesis and belongs to <i>orientation</i> because of its gradability which comprises the horizontal direction of a linear scale, as does [b]. However, [b] also belongs to <i>motion</i> since a blockade can be interpreted as a moving object.				
3 4	"Thus, in ECAT3 knockout cells, the neomycin resistance gene is expressed from the enhancer and promoter of ECAT3, which WAS ACTIVE ONLY IN ES CELLS and EARLY EMBRYOS, but NOT IN SOMATIC CELLS [a]. Somatic cells, such as mouse embryonic fibroblasts (MEFs) derived from the ECAT3 knockout mice ARE SENSITIVE TO G418, whereas ECAT3 knockout ES cells were RESISTANT TO HIGH CONCENTRATIONS [b] of G418" (p. 274)	a. intermediate/ contradictory opp. b. contrary opp.	Yes	a. No b. Yes (orient.)
The antithesis are active in this excerpt. [a] comprises intermediates because these antitheses comprise "ES cells and early embryos" and "somatic cells". Somatic cells comprise many different cells – hence the antithetical pair is a intermediate. Meanwhile, [a] is also a contradictory opposition because of the pair "was active only in" and "not in". Because of "not", these antithetical elements are each other's exact opposite, hence contradictory opposition. [b] is a contrary opp. since it comprises "sensitive to" and "resistant to", which is gradable on a linear scale. Therefore [b] also belongs to the spatial conceptual antithesis ( <i>orientation</i> , which all the other contrary oppositions belong to). [a] however, does not belong to any spatial concepts because it comprises cell types.				
5	"Next, to determine which of the 24 candidates were critical, Kazutoshi examined THE EFFECTS OF WITHDRAWAL of individual factors from the pool of transduced candidate genes. ES cell-like colonies did not form when either OCT3/4 or Klf4 was REMOVED. The REMOVAL of Sox2 resulted in only a few ES-like colonies. When he REMOVED c-Myc, the ES cell-like colonies did emerge, but these had a flatter, non-ES-cell-like morphology". (p. 275)	intermediate	Yes	Yes (motion)
This excerpt is founded on antithesis, not least the entire method. By taking away one factor at a time, Yamanaka is creating contrast and discriminates the factors from one another. Due to these various factors, the antithesis is a intermediate "Removing"/"removal" and such entail movement, and hence it belongs to <i>motion</i> .				
6 7	"This was in part because, although MOUSE ES cells and HUMAN [a] ES cells share many SIMILAR features, they are very DIFFERENT [b] in many aspects, including the culture conditions and morphology" (p. 275)	a. contradictory opp. b. contradictory opp./intermediate	Yes	No
Antithesis [a] is a contradictory opp. comprising mouse and human ES cells. It is active but it is not spatial. [b] is				

also a contradictory opp. since it discusses similarity and difference among these ES cells from the different species. However, the similarities as well as the differences are not being specified, and hence the antithesis is also a intermediate				
<b>8 9</b>	“With the iPS cell technology, all that is needed is a TINY AMOUNT [a] of BLOOD CELLS [b] from the patients. We can then generate iPS cells, EXPAND the cells as much as [a] we want, and then make HEART CELLS or BRAIN CELLS [b] to specifically study the affected tissues” (p. 276-77)	a. contrary opp. b. intermediate	Yes	a. Yes (orient., space) b. No
In this excerpt, [a] is an active contrary opposition, which describes the amount of blood cells – in the first case, it is a “tiny” amount, and in the second it is a much larger amount, implicated by “expand the cells as much as”. This antithesis is gradable, can be put on a linear scale, and hence also belongs to the spatial concept <i>orientation</i> . Furthermore, since an amount can be view in space, the antithesis could also be a part of the spatial concept space. [b] is also active, but is a intermediate because it comprises many different cell types – blood cells, heart cells and brain cells. Because it describes cell types it does not belong any spatial concepts (i.e. not <i>motion</i> , <i>orientation</i> , or <i>space</i> ).				
<b>10</b>	“However, this artificial system suffers from both false POSITIVE and false NEGATIVE results” (p. 277)	contradictory opp.	Yes	No
Since this active antithesis deals with an either-or-relationship (in this context the false results are either positive or negative) it is a contradictory opp. Because positive and negative can be interpreted as a vertical direction in space, positive is up and negative is down, it belongs to <i>orientation</i> .				

## THE MOLECULAR MACHINERY OF NEORUTRANSMITTER RELEASE

This lecture, held by Thomas C. Südhof, 7<sup>th</sup> December 2013<sup>©</sup>, and discussed how neuro signals (containing small signal molecules) are passed on from one neuron to another by means of vesicles, small “bubbles” held together by cell membrane.

	<b>Antithesis</b>	<b>Sub-group</b>	<b>Active</b>	<b>Spatial</b>
<b>1</b>	“neurotransmitter release had been described in exquisite PHYSIOLOGICAL detail. However, there was no MECHANISTIC understanding” (p. 262)	intermediate	Yes	No
This antithesis describes how the mechanism of neurotransmitter release has been and has not been studied (in physiological and mechanistic detail respectively). It is an intermediate antithesis since the mechanism can be described in more ways.				
<b>2</b>	“synapsins and synaptophysins turned out to have only ancillary roles in the synaptic vesicle cycle that may be IMPORTANT for the overall organism, but are NOT ESSENTIAL for the basic process of synaptic vesicle exo- and endocytosis” (p. 264)	contrary opp.	Yes	Yes (orient.)
This active antithesis explains how proteins (in this case, synapsins and synaptophysins for instance) can be important from one perspective and less important from another perspective. How important something is can be explained according to a linear scale, hence orient.				
<b>3</b>	“and that only the SNARE COMPLEX BUT NOT INDIVIDUAL SNARE proteins binds to SNAPs and NSF, WHILE ONLY FREE SNARE proteins BUT NOT SNARE proteins IN THE COMPLEX are substrates for botulinum and tetanus toxins” (p. 265)	contradictory opp.	Yes	Yes (motion, space)
This is an active antithesis, describing a contradictory opposition between a complex put together by different proteins and all these different free proteins, and how they work in oppositional ways. Since they “bind” they belong to the motion-category and since they are described in terms of how they are oriented in space, they also belong to space.				
<b>4</b>	“that yeast NSF DOES NOT function IN fusion, BUT IS ONLY required to ACTIVATE SNARE proteins FOR fusion and to RECYCLE the SNARE machinery AFTER fusion” (p. 266)	intermediate	Yes	Yes (motion, space)
This active antithesis describes how yeast NSF functions and how it does not function in relation to the fusion mechanism, and that is functions in multiple ways (hence intermediate). Because it describes how NSF works in space yeast and what motional mechanisms are involved it belongs to the spatial categories motion and space.				
<b>5</b>	“On the ONE hand (...) On the OTHER hand” (p. 267)	contradictory opp.	Yes/No	No
This excerpt deals with a longer paragraph in the text and is therefore intersentential (whilst almost all other elicited anonyms are intrasentential). It is active since it does state “one the one/another hand”, but is implicit in the sense that they are parted from each other in different parts of the text. It is a contradictory opposition, and is not spatial.				
<b>6</b>	“Thus, paradoxically at this junction Munc18-1 seemed to be at the same time ESSENTIAL FOR FUSION itself and PREVENTING FUSION by blocking SNARE-complex assembly” (p. 267)	contradictory opp.	Yes	Yes (motion)
This contradictory opposition is an active antithesis that describes how the protein Munc18-1 is both enhancing and preventing something. It belongs to the spatial category motion.				
<b>7</b>	“were DESTABILIZED (---) suggesting that the complex of Munc18-1 with the closed conformation of Syntaxin-1 STABILIZES both proteins” (p. 271)	contradictory opp.	Yes	Yes (motion)
This is an explanatory excerpt consisting of a contradictory opposition in which Munc18-a either destabilizes or stabilizes (a motion, hence the spatial category motion) the complex consisting of Munc18-a and Syntaxin-1.				
<b>8</b>	”Even the fusion of individual vesicles, as judged by the	contradictory	Yes	Yes (space)/ No

	kinetics of single miniature release ('mini') events, was faster in <i>Syntaxin-1</i> <sup>OPEN</sup> THAN IN WILD-TYPE synapses" (p. 271)	opp.		
This active antithesis is describing how two different synapses – (in this case just two, hence contradictory) the usual one and a mutated one – have different characteristics concerning the release speed of vesicles. From one perspective, this antithesis does not belong to a spatial category. However, if interpreted as categories, the antithetical pair belongs to <i>space</i> .				
9 10	"What then do SM proteins do in fusion? The fact that SM proteins are required continuously during SNARE complex assembly argues for a role EITHER [a] in ORGANIZING [b] proper SNARE-complex assembly and in preventing dead-end inappropriate SNARE complexes, OR [a] in CATALYZING [b] lipid mixing during fusion" (p. 272-73)	contradictory opp.	Yes	a. No b. Yes (motion)
The either/or as well as organizing/catalyzing are contradictory oppositions (either/or inflicting the characterization of organizing/catalyzing). They are both active, but a) is not spatial, which b) is since it is "doing" something, hence motion. This excerpt describes a cause-effect-relationship.				
11 12	"For example, different from Syt1 C2-domains, some C2-domains exhibit A HIGH INTRINSIC Ca <sup>2+</sup> -AFFINITY [a] also in the ABSENCE [b] of phospholipids" (p. 275)	a. contradictory/contrary opp. b. contradictory opp.	No	a. Yes (orient.) b. Yes (space)
Neither of the antithesis is active but [a] together with [b] (contradictory opp.) implies that there could be a high intrinsic Ca <sup>2+</sup> -affinity also in the presence of phospholipids (molecules structuring the membrane) in Syt1 C2-domains. [a] belongs to orient. because high implies low which comprise a linear scale (contrary opp.) whilst [b] belongs to space since one describes whether something is there or not.				
13 14	"We showed in a detailed comparison of the R233Q and D232N point mutations, which DECREASE or INCREASE [a] the apparent Ca <sup>2+</sup> -affinity of Syt1, respectively, that they have CORRESPONDING OPPOSITE EFFECTS [b] on the apparent Ca <sup>2+</sup> -affinity of release" (p. 279)	a. contrary/contradictory opp. b. contradictory opp.	a. Yes b. No	a. Yes (orient., motion) b. No
The first antithesis [a] is active and comprise both a contrary and a contradictory opp. since the pair can be put at the ends of a linear scale, and since they comprise an either/or relationship. Hence it belong both to orient. (contrary opp.) as well as motion. [b] is however implicit but by stating that the opposite (contradictory opp.) is happening, one still understands what that means. It does not belong to a spatial category.				
15	"In vitro fusion assays suggested that complexins act only as A CLAMP OF FUSION (---), whereas in analyses of synaptic transmission of autapses (---), complexins acted only as AN ACTIVATOR OF Ca <sup>2+</sup> -triggered fusion" (p. 287)	contradictory opp.	Yes	No
This antithesis is active and does not belong to a spatial category. It however comprises a contradictory opp. because it describes two different cases and the function of complexins in these cases.				
16	"However, it is likely that the clamping function of complexin is relatively LESS IMPORTANT THAN its activation function" (p. 288)	contrary opp.	Yes	Yes (orient.)
This active antithesis describes how important something is in relation to complexin. This can be put on a linear scale and is hence orient.				
17 18	"and that Ca <sup>2+</sup> DOES NOT [a] cause ALL-OR-NONE [b] binding of synaptotagmin to the SNARE complex as it DOES [a] for binding of synaptotagmin to phospholipids, but INSTEAD causes a rearrangement of the pre-fusion complex" (p. 289)	contradictory opp.	Yes	a. Yes (motion) b. No
The antithesis are active and of a contradictory opp.-character where [a] explains what the calcium ions are not and are doing, and [b] (as an expression) is describing an all-or-nothing-relationship. [a] belongs to the spatial category motion because it is causing something. [b] is however not spatial.				
19	"synaptotagmins that LACK N-terminal disulfide bonds (---), but what about the other 4 Ca <sup>2+</sup> -binding synaptotagmins that ARE disulfide-bonded" (p. 289)	contradictory opp.	Yes	No
Here there is either disulfide bonds (a bond characterization) or there is none, hence contradictory opp. The				

antithesis is active and is not spatial.				
20	“Specifically, we found that Syt10 functions in olfactory neurons as a Ca <sup>2+</sup> -sensor for specialized vesicles containing IGF-1. These VESICLES differ from NEUROPEPTIDE-CONTAINING VESICLES present in the same neurons (which are more like neuroendocrine granules and contain Syt1)” (p. 291)	intermediate	Yes	Yes (space)
This active antithesis describes that vesicles are different from one another in <i>one</i> sense (hence, intermediate). The antithesis is spatial since the vesicles “contain” something.				
21	“Interestingly, most of these proteins DIRECTLY or INDIRECTLY bind to each other” (p. 293)	contradictory opp.	Yes	No/Yes (motion)
This active antithesis describes how the proteins bind to each other in terms of either/or (hence contradictory). Because they “bind” they could belong to the motion-category, but if restricting the antithesis to only directly/indirectly, there is no spatial concept.				
22	“RIMs are critical not only for tethering/docking synaptic vesicles, but also for recruiting Ca <sup>2+</sup> -channels to the active zone, for mediating SHORT- AND LONG-TERM presynaptic plasticity” (p. 294)	contrary opp.	Yes	Yes (orient.)
Because the active antithesis exists of a pair that can be put on a linear scale they are contrary opp. and hence orient. This excerpt is explanatory.				
23 24 25	“It should be noted that NO OTHER PROTEINS BESIDES RIMs [a] were found to be essential for synaptic vesicle docking when such docking was analyzed in electron micrographs of CHEMICALLY FIXED and TRADITIONALLY STAINED [b] sections. However, a COMPLETELY DIFFERENT [c] picture emerges when electron microscopy is performed on UNFIXED, RAPIDLY FROZEN TISSUE [b] – now, A LARGE NUMBER OF ADDITIONAL [a] genes were found to be essential for ‘docking’” (p. 294)	a. contrary opp./ intermediate b. intermediate c. contradictory opp.	Yes	No
[a] is a contradictory opp. because it describes an all-or-nothing-relationship. However [a] is also a intermediate when compared with the expression “a large number of additional genes”, since the all-or-nothing-relationship now stands in relation to not all genes but only a few of them; [b] is an intermediate because it describes in what ways the essentiality of the proteins were tested; [c] is contradictory opp. since it explains what was discovered when then the docking was analyzed in a different way. All antithesis are active, and none is spatial (and if so, it is not obvious).				
26	“It should also be noted that ‘DOCKING’ OF SECRETORY GRANULES in chromaffin cells behaves differently from DOCKING OF SYNAPTIC VESICLES at the active zone” (p. 295)	contradictory opp.	Yes	Yes (motion)
This active antithesis describes two different dockings, which in this case are contradictory. Docking implies the category of motion.				

## DNA ENDS: JUST THE BEGINNING

The following lecture was presented 7<sup>th</sup> December 2009<sup>©</sup>, by Jack W. Szostak. His lecture discusses the finding of telomeres, what functions they have, and how they are maintained (by a “lengthening-molecule”, so called telomerase). Telomeres are found at the chromosome ends. There is a correlation between the length of the telomeres and for how long the cell lives before it kills itself.

	<b>Antithesis</b>	<b>Sub-group</b>	<b>Active</b>	<b>Spatial</b>
<b>1</b>	“The ends of broken chromosomes are very reactive and DO things that normal chromosome ends NEVER DO” (p. 333)	contradictory opp.	Yes	No
This antithesis is active and spatial in the sense that “do” implies movement, and hence it belongs to <i>motion</i> . It is a contradictory opposition because it comprise two distinct poles – “do” and “never do”.				
<b>2</b>	“BREAKAGE-FUSION-bridge-cycle” (p. 333)	reverse contrary opp.	Yes	Yes (motion)
This is a reverse contrary opposite because from breakage, there can be fusion and vice versa (“cycle” does also imply this). Because cycle connotes movement it hence belongs to the spatial category <i>motion</i> .				
<b>3</b> <b>4</b>	“the LEADING [a] strand CAN GO [b] all the way to the end, but the LAGGING [a] strand CANNOT [b]...” (p. 335)	a. contradictory/ reverse contrary opp. b. contradictory opp.	Yes	a. Yes (orient.) b. Yes (motion)
[a] is a contradictory opp. because it deals with the two strands, comprising DNA. Meanwhile, they could also be interpreted as a reverse contrary opposition because leading and lagging are, in this context, each other’s reverse contraries. Since the strands are typically regarded as strings, these expressions belong to <i>orientation</i> . [b] is contradictory because is, as in <b>1</b> , deals with an either/or-relationship (can/cannot), and because it has to do with “go” in hence belongs to <i>motion</i> .				
<b>5</b>	“If this RNA primer is generated at an INTERNAL site, any DISTAL DNA will remain unreplicated” (p. 335)	contrary opp.	Yes	Yes (orient.)
This is an active contrary opposition since distal and internal can be put on a linear scale where one can discuss how distal or how internal something is in relation to something else. Because it deals with some kind of direction, it hence belongs to <i>orientation</i> .				
<b>6</b>	“PLASMID DNA that were homologous to a segment of a YEAST CHROMOSOME” (p. 337)	intermediate	Yes	Yes (orient.)
This active antithesis has intermediates because even though a plasmid DNA (which is circular) could be interpreted as the opposite to a yeast chromosome (which is linear), a plasmid DNA could also be the opposite to a human chromosome, a primate chromosome, or maybe a bird chromosome. Since the antithesis deals with how the DNAs are organized in terms of either a circle or a linear string, hence some kind of direction, if belongs to <i>orientation</i> .				
<b>7</b>	“the Holliday JUNCTIONS can be RESOLVED” (p. 337)	reverse contrary opp.	Yes	Yes (motion)
This active antithesis is a reverse contrary opposition since this structure, the Holliday junction [a structure between the four strands of two chromosome pairs], comprise a process in which the four DNA strands of two chromosome pairs bind to each other, and then resolve. When things bind to and resolve from each other, movement is included, hence the antithesis belongs to the spatial category <i>motion</i> .				
<b>8</b>	“to yield CROSSOVER or NON-CROSSOVER configurations” (p. 337)	contradictory opp.	Yes	Yes (motion, orient.)
This active antithesis is of course a contradictory opposition because of the “non-“ in front of one of the terms comprising the antithetical pair. It belongs to both <i>motion</i> and <i>orient</i> . since “crossover” can be interpreted as something going (movement) across something else, and since it can be interpreted as two lines crossing each				

other, which deals with direction, hence orient.				
9	“double-strand-BREAK-REPAIR” (p. 337)	reverse contrary opp.	Yes	Yes (motion)
This active antithesis is a reverse contrary opposition, because (generally), when there is a break in both strands comprising DNA, it is being repaired (reversing the break, i.e. healing it so that the strands become fused together again). This expression is a term in molecular genetics. Because this pair implies movement is belongs to <i>motion</i> .				
10 11 12	“This unicellular organism is very DIVERGENT FROM [a] metazoans, and has an UNUSUAL cell biology characterized by the presence of both a MICRONUCLEUS [b] with NORMAL chromosomes [c] and a MACRONUCLEUS [b] in which the chromosomal DNA HAS BEEN CHOPPED INTO THOUSANDS OF SMALL FRAGMENTS [c], many of which become highly amplified” (p. 338)	a. contradictory opp., intermediate b,c. contrary/ contradictory opp.	Yes	a. No b. Yes (space, orient.) c. Yes (motion, orient.)
All antitheses are active contradictory oppositions. [a] describes the two different structures of DNA, CIRCULAR/LINEAR, whilst [b] describes what these structures look like on the gel – they are either a SERIES OF BANDS or one SINGLE BAND; [c] deals with either MONOMERS (single) or MULTIMERS (many); and [d] is contradictory because either the circular DNA is firmly twisted (SUPERCOILED) or not (RELAXED). [a] belongs to <i>orientation</i> because it describes a structures with some kind of vertical or horizontal direction (maybe not in the case of CIRCULAR). [b] belongs to <i>space</i> and <i>orientation</i> because what these bands look like can be interpreted in an abstract space, and because a series of something (as well as the bands themselves) has a direction. [c] belongs to <i>space</i> (it describes a structure, in space). [d] belongs to both <i>motion</i> and <i>orientation</i> because supercoiled or relaxed are words related to movement, and they also deals with an abstract structure in space, going in some kind of direction.				
13	“they seemed to BEHAVE JUST LIKE NORMAL chromosomal telomeres. They clearly BEHAVED COMPLETELY DIFFERENTLY from” (p. 338)	contradictory opp.	Yes	No
This antithesis is active and does not belong to any spatial category. It is a contradictory opp. because of normal/completely different – two poles which are each other’s opposites without any intermediary in between.				
14	“ <i>Tetrahymena</i> and yeast are so very DISTANTLY RELATED” (p. 338)	contrary opp.	No	Yes (orient.)
This antithesis is not active in the sense that it is implicitly understood that these organisms are not alike from a genetic perspective. However, by saying that they are distantly related, it comprises a contrary opp. where they could be closely related, distantly related or “intermediary” related. Because it can be put on a linear scale it hence belongs to the spatial category <i>orientation</i> .				
15 16 17	“When INTACT [a] circular plasmid DNA of this type is used to transform Yeast cells, MANY transformants ARE RECOVERED [b] and they almost ALL contain replicating CIRCULAR [c] DNA molecules. As I explained above, if the plasmid DNA is CUT [a] with a restriction enzyme (in a region that is not homologous to yeast genomic DNA) so as to generate LINEAR [c] DNA with ‘broken ends’, those ends do NOT FUNCTION as stable telomeric ends and as a result VERY FEW transformants ARE RECOVERED [b]” (p. 340)	a,c. contradictory opp. b. contrary/ contradictory opp.	Yes	a,b. Yes (motion) c. Yes (orient.)
All antithesis are active and contradictory. [a] is contradictory because it deals with either an intact circular plasmid (short version of DNA for specific purposes) or a broken (cut) one; [b] is contradictory because it either many are recovered or very few are; [c] is contradictory because either DNA is circular or linear. [a] and [b] belong to <i>motion</i> because “cut” and “recover” imply movement, whereas [c] belongs to <i>orientation</i> since circular/linear implies some abstract, spatial structure in space.				
18 19	“I was then able to ask whether the PLASMID [a] DNA was replicating as a LINEAR molecule [a,b], which would mean the telomeres were working, OR whether I had only recovered standard replicating CIRCULAR PLASMIDS [b]” (p. 340)	contradictory opp.	Yes	a. Yes (orient.) b. Yes (motion, orient.,)
Regarding antithesis [a], see 17. Antithesis [b] comprises the contradictory opp. of a plasmid turning into a linear structure, or if it stays the same, i.e. a circular structure. [b] hence belongs to both <i>motion</i> and <i>orientation</i> because it deals with a transformation of the structure of the plasmid, and because it deals with the same as [a].				



20	“I DISTINGUISHED BETWEEN LINEAR and CIRCULAR DNA forms by gel electrophoresis” (p. 340)	contradictory opp.	Yes	Yes (orient.)
See 15 [a]				
21 22 23 24	“When DNA molecules are separated by gel electrophoresis, CIRCLES [a] generate a SERIES OF BANDS[b] corresponding to MONOMERS [c] and MULTIMERS [c], and RELAXED[d] and SUPERCOILED [d] forms, leading to a complicated pattern. LINEAR [a] DNA molecules don’t have any of those alternative forms, so they migrate as a SINGLE BAND [b]” (p. 340)	contradictory opp.	Yes	a. Yes (orient.) b. Yes (space, orient.) c. Yes (space) d. Yes (motion, orient.)
All antitheses are active contradictory oppositions. [a] describes the two different structures of DNA, CIRCULAR/LINEAR, whilst [b] describes what these structures look like on the gel – they are either a SERIES OF BANDS or one SINGLE BAND; [c] deals with either MONOMERS (single) or MULTIMERS (many); and [d] is contradictory because either the circular DNA is firmly twisted (SUPERCOILED) or not (RELAXED). [a] belongs to <i>space</i> and <i>orientation</i> because what these bands look like can be interpreted in an abstract space, and because a series of something (as well as the bands themselves) has a direction. [c] belongs to <i>space</i> (it describes a structure, in space). [d] belongs to both <i>motion</i> and <i>orientation</i> because supercoiled or relaxed are words related to movement, and they also deals with an abstract structure in space, going in some kind of direction.				
25 26	“Most of them were INTERNAL [a] fragments, but the occasional fragment from the END OF [a] a chromosome would have one RESTRICTION CUT [b] end and one end DERIVED FROM A YEAST TELOMERE [b]” (p. 341)	contradictory opp.	Yes	a. Yes (orient.) b. No
Both antithesis are active. [a] is, in this context, a contradictory opposition because it discusses either internal fragment or fragment at the end of a chromosome. It belongs to <i>orientation</i> since the antithetical pair can be put on a linear scale. [b] is a contradictory opposition because in entails a chromosomal end that has a cut from an restriction enzyme, and one end that comes from yeast.				
27	“This DNA molecule, which had one FUNCTIONAL telomeric end and one NON-FUNCTIONAL ‘broken’ end” (p. 341)	contradictory opp.	Yes	Yes (motion)
This is obviously an active antithesis and a contradictory opposition (because of “non-“). Since “function” connote movement, the antithesis belongs to <i>motion</i> .				
28	“While yeast DID FIT the general finding of a GT rich 3’- terminal strand, the absence of simple repeats was puzzling, and DIDN’T SEEM TO FIT easily into the prevailing” (p. 342)	contradictory opp.	Yes	No
This active antithesis is contradictory because of “did” and “did not”. It does not belong to a spatial category.				
29	“so that instead of being MAINTAINED over many cell cycles it was LOST AT A HIGH FREQUENCY “ (p. 342)	contradictory/ contrary opp.	Yes	Yes (orient.)
This active antithesis is both a contradictory and a contrary opposition. Either something is maintained or it is lost (contradictory), but by saying that is can be lost with a frequency implies a contrary opp. One can put how lost something is on a scale in terms of frequency, and hence contrary. Therefore the antithesis belongs to <i>orientation</i> .				
30	“To our SMALL artificial chromosomes, he was able to make much BIGGER DNA molecules” (p. 343)	contrary opp.	Yes	Yes (orient.)
This antithesis is active and it is a contrary opposition since one can put how big or small something is on a scale. Because of this abstract, linear scale, the antithesis belongs to <i>orientation</i> .				
31 32	“Cells with HIGH LEVELS [a] of telomerase activity CAN DIVIDE WITHOUT LIMIT [b], because they maintain functional telomeres. In contrast, cells with INSUFFICIENT [a] telomerase activity cannot maintain telomere length, and as a result HAVE LIMITED DIVISION [b] potential. (p. 347)	a. contrary opp. b. contradictory opp.	Yes	a. Yes (orient.) b. Yes (motion, orient.)
Both antithesis are active. Antithesis [a] is a contrary opposition because it entails “high” and “insufficient”. These are not lexical antithetical elements but high implies “a lot”, or “sufficient” once one encounters the expression “insufficient”. Because the antithesis is contrary it belongs to <i>orientation</i> but also since “high” implies a vertical direction. Antithesis [b] is active and is a contradictory opposition since it either dived without a limit or with. Dividing implies movement and hence <i>motion</i> . However, the “limit” could be some kind of line, symbolizing an end, and because a line is a direction in space, then the antithesis belongs to <i>orientation</i> as well.				

33	"prepare HUGE COLLECTIONS of RANDOM sequences, and then isolate the RARE functional molecules that did WHAT WE WANTED" (p. 349)	contrary opp.	No	Yes (space)
This antithesis is not active, however it entails the pair "huge collection of random sequences" and "rare". Rare implies that there are not some many, which can be interpreted as an opposite to "the huge collection" which implies many. This can be viewed on an abstract, spatial scale, hence contrary, hence <i>orientation</i> . Moreover the antithesis could belong to the spatial category <i>space</i> as well since a collection can be interpreted as a mass in space.				
34	"However, the GROWTH and DIVISION of the protocell..." (p. 354)	reverse contrary/ contrary opp.	Yes	Yes (motion, orient.)
The antithesis is active. It is a reverse contrary opposition because either a cell is growing or dividing (or neither), which are reverse contrary mechanisms. However it could also be a contrary opposition since there is the intermediary of doing neither", and because growing and dividing concerns the size of the cell, and size is a matter of something that is gradable on a scale. It belongs to both <i>motion</i> (growing, dividing) and <i>orientation</i> (scale).				
35	"What we are doing is making synthetic nucleotides that are modified so as to become MORE REACTIVE" (p. 355)	contrary opp.	Yes/No	Yes (orient.)
The antithesis is active in the sense that one is comparing the usual nucleotides used with the ones they are making. By saying that they are meant to be "more" reactive means that there are nucleotides being "less" reactive as well, hence a gradable scale, hence a contrary opposition, hence <i>orientation</i> . However, "less" is implicit and therefore the antithesis is also non-active, and maybe more so than active in this context.				
36	"DNA ENDS: Just the BEGINNING" (p. 333)	contradictory opp.	Yes	Yes (orient., motion)
Even though ENDS deals with DNA and BEGINNING deals with a time-related, linguistic expression, they are still an antithetical pair, an active contradictory opposition. It is contradictory because it comprises the pair END/BEGINNING, antithesis which are each other's direct opposites. Meanwhile, because it also entails DNA as a structure (which is linear) and time (which can be interpreted a linear concept and something that is moving), it is a spatial conceptual antithesis, belonging to both <i>orientation</i> as well as <i>motion</i> .				

## TELOMERASE DISCOVERY: THE EXCITEMENT OF PUTTING TOGETHER PIECES OF THE PUZZLE

This Nobel Lecture, was presented by Carol W. Greider on the same day as and Szostak, i.e. 7<sup>th</sup> December 2009<sup>©</sup>. For description of lecture, please view Szostak's lecture.

	Antithesis	Sub-group	Active	Spatial
1	"it was clear that a chromosome END differed from a chromosome BREAK" (p. 297)	contradictory opp./ intermediate	Yes	Yes (orient.)
This antithesis is active and discusses two different ways (hence contradictory opp.) of viewing a chromosome end – either as a normal chromosome end, or as a chromosome break. Because such a break can be induced in several ways, the antithesis can also be categorized as a intermediate Since it deals with the structure of a chromosome, which is linear, it belongs to <i>orientation</i> .				
2	"yielding BLURRED (or 'FUZZY') bands, rather than the SHARPER, more DINSTINCT bands that are typical of restriction fragments which are all of a similar size" (p. 298)	contrary opp.	Yes	Yes (orient.)
The active antithesis above does belong to contrary opp. because it describes <i>how</i> either blurred or sharp the band (on the gel – a method where substrates, proteins or DNA/RNA, can be separated and defined) is. This is a gradable characteristic, hence contrary. Due to the gradability and the abstract interpretation of one such, it belongs to <i>orientation</i> . Moreover, this characteristic of the bends also deals with orientation on a gel, which – again – makes it possible to categorize them in terms of <i>orientation</i> .				
3	"This elongation was unexpected. In fact, it was THE OPPOSITE of what had been predicted" (p. 299)	contradictory opp.	Yes/No	Yes (motion, orient.)
This antithesis is both active and non-active. It is active in the sense that the text says it was predicted the opposite, and as a reader one has to assume the opposite of elongating, which is some kind of shortening. Since "the opposite" was predicted, it is thus the direct opposite, and hence it is a contradictory opposition. Due to "elongation", the antithesis belongs to <i>motion</i> . And if something is elongating (or that something is being removed), it is getting longer (or shorter), a vertical or horizontal (or something in between) direction becomes involved in the interpretation, and hence the antithesis also belongs to <i>orientation</i> .				
4	"a CIRCULAR yeast plasmid and cut it once with a restriction enzyme to make it LINEAR" (p. 299)	contradictory opp.	Yes	Yes (orient.)
When one discusses DNA, as one is above (a plasmid is a circular piece of DNA), one is either classifying the DNA as circular or linear (by stating both these, the antithesis is thus active), which is why the antithesis is a contradictory opp. Moreover, due to these structures (linear or circular) is also belongs to <i>orientation</i> .				
5	"To do this, they REMOVED one end of the linear plasmid to which <i>Tetrahymena</i> telomeres has been added, and LIGATED random genomic fragments of yeast" (p. 299)	reverse contrary opp.	Yes	Yes (motion)
This antithesis depicts a reverse contrary opposition, removed/ligated (glued together). Since both antithesis of the pair is explicit it is active, and because it entails movement, is belongs to <i>motion</i> .				
6	"the <i>Tetrahymena</i> telomeres on the plasmid maintained in yeast were LONGER than they had started out" (p. 300)	contrary opp.	No	Yes (orient.)
This antithesis is non-active, but is a contrary opp. due to that length is a gradable characteristic. Also, due to its gradability, and that length is a vertical direction, it belongs to <i>orientation</i> .				
7	"whereby DNA was generated DE NOVO rather than being the result of RECOMBINATION (p. 301)	contradictory opp.	Yes	Yes (motion)
In this excerpt, "de novo" is the opposite to "recombination" in the sense that de novo entails "new" and recombination entail "old" or "reused" – hence a contradictory opposition. Recombination is a mechanisms which deals with movement, and therefore the antithesis could belong to <i>motion</i> .				
8	"no KNOWN enzyme could do the sequence addition, and so proposed instead that there must be an UNKNOWN enzyme that adds telomere	contradictory opp.	Yes	No

	sequences” (p. 301)			
Due to this dichotomous expression (known/unknown), the active antithesis is a contradictory opp. and does not entail spatiality.				
9	“The first assay we tried explored whether a piece of DNA that INCLUDED A TELOMERE could incorporate DNA precursors more readily than a piece of DNA CONTAINING NON-TELOMERIC SEQUENCE sequences” (p. 303)	contradictory opp.	Yes	No/Yes (orient.)
This antithesis is an active contradictory opposition – wither the DNA contains a telomeric structure or it does not. It is not a spatial conceptual antithesis because it cannot be related to <i>motion</i> , <i>orientation</i> and <i>space</i> . Meanwhile, if one interpret it as DNA being a long structure, and one interprets these telomeric or non-telomeric as being a part of the vertical linear structure, the antithesis could belong to <i>orientation</i> .				
10	“if it did, we expected to see more of the <sup>32</sup> P label incorporated into THE TELOMERIC END than THE END LACKING A TELOMERE” (p. 303)	contradictory opp.	Yes	Yes (orient.)
The same reasoning as above applies for this antithesis. However, here one explicitly discusses the telomeres, and since telomeres are part of DNA – as being the ends – the antithesis does belong to <i>orientation</i> .				
11	“We also added RADIOLABELED dCTP and dGTP and UNLABELED dATP and dCTP to serve as DNA precursors” (p. 303)	contradictory opp.	Yes	No
This is too a contradictory opposition due to the direct opposites labeled/unlabeled. And because both expressions are explicit in the sentence, the antithesis is active. It is however not spatial.				
12 13	“I cut the DNA fragment to generate two UNEQUAL SIZED [a] fragments to distinguish between the TELOMERIC AND NON-TELOMERIC[b] ends. (---) We could then separate and identify the two DIFFERENT-SIZED [a] fragments on an agarose gel” (p. 303)	a. contradictory/contrary opp. b. contradictory opp.	Yes	Yes (orient.)
Antithesis [a] is a contradictory opposition because it just separates two groups (unequal sized/different-sized). It is however also a contrary opp. since size in this case is a gradable quality and hence can be put on a linear scale, i.e. it can be interpreted as a horizontal direction. Therefore it belongs to <i>orientation</i> . [b] compared to [a] is however explicit and therefore active. The same reasoning applies here as for antithesis 10.				
14	“RATHER looking for INCREASED label incorporation, we decided to look for CHANGES IN THE SIZE of the fragments. If there was an enzyme that extended telomeres not only should the telomeres become labeled with the radioactive precursors, but <i>also</i> the size of the fragment should increase as the telomere is extended” (p. 304)	contradictory opp./intermediate	Yes	Yes (motion, orient.)
This is an antithesis in the sense that they describe what one probably is doing in general, but that they do something else – they are looking for changes in the size. Since they might have been able to do something else apart from that, the antithesis could be a intermediate, meanwhile – in this context, these are the <i>two</i> different parameters measured, and therefore the antithesis could also be a contradictory opp. Since “increase” entails movement, it belongs to <i>motion</i> , and since the “changes in the size” entails a vertical structure (since telomeres are a part of DNA which generally is interpreted as helical, yet linear structures, it also belongs to <i>orientation</i> .				
15	“The repair polymerases in the extracts, which could cause both TELOMERE and NON-TELOMERE [a] ends to be labeled would not be capable of generating DNA that was LONGER THAN the fragments added AT THE START[b] of the essay” (p. 304)	a. contradictory opp. b. contrary opp.	Yes	Yes (orient.)
Regarding the active antithesis [a], the same reasoning applies here as for 10. [b] however is a contrary opp. since it entails time (“at the start”). Time is gradable and is interpreted as something moving forward, hence <i>orientation</i> .				
16 17	“a small change in size of a LARGE [a] fragment would be too HARD TO DETECT [b], but a small change in size of a VERY SMALL [a] fragment	a. contrary/contradictory opp. b. contrary opp.	Yes	Yes (orient.)

	would be NOTICEABLE [b]" (p. 304)			
These two antitheses are both active and are contrary, gradable oppositions: [a] large/small, [b] hard to detect/noticeable. Because they are gradable and can be interpreted as a linear scale, they both belong to <i>orientation</i> , and are thus spatial conceptual antithesis.				
18	"The NON-TELOMERE and TELOMERE fragments were then separated on a gel that was usually used for DNA sequence analysis and which could distinguish between fragments that differed in length by just a single base" (p. 304)	contradictory opp.	Yes	Yes (orient.)
The same reasoning applies here as for antithesis 10.				
19	"Instead of a LONG LINEAR DNA FRAGMENT, I tested a SYNTHETIC 18 RESIDUE OLIGONUCLEOTIDE (TTGGG) <sub>4</sub> as the substrate" (p. 304)	contrary opp.	Yes	Yes (orient.)
This antithesis concerns the size (in length) of the DNA fragment. For those who are familiar with the expression "oligonucleotide" know that this is a short piece of a (here) DNA sequence – and therefore an antithesis exists between "long linear DNA fragment" and this oligonucleotide since it implies a short fragment. Since length is gradable, it is hence a contrary opposition, and because it can be interpreted on an abstract, linear scale – and of course deals with length – it hence belongs to <i>orientation</i> .				
20	"we thought the TTGGGG primer might be ANNEALING TO DOUBLE-STRANDED GENOMIC DNA that might be present as a contaminant, such that a conventional polymerase could generate the TTGGGG repeat addition when replicating the DNA. Alternatively, the primer might BE SELF-ANNEALING (that is, pairs of the primer might be sticking to one another)" (p. 306)	contradictory opp.	Yes	Yes (motion)
This antithesis is active and comprises "annealing to double-stranded genomic DNA" and "be self-annealing". What is annealing (attaches itself) to DNA is a primer which is a short RNA sequence). This antithesis presents an either-or-relationship, and is hence contradictory. Because the primer is doing something, it could belong to the spatial category <i>motion</i> .				
21	"The final experiment that convinced both Liz and me that we had something new was when we did the correlative of the experiment that Liz and Jack Szostak had done, which had been published in Cell in 1982. They had put Tetrahymena telomeres into yeast cells and shown that a yeast telomeric sequence was added to the ends. By contrast, we made a synthetic yeast sequence telomere oligonucleotide primer and put it in Tetrahymena extracts – and found that the Tetrahymena telomere repeats were added to the yeast telomere" (p. 308)	contradictory opp.	Yes	No
This is an antithesis in the sense that Greider describes what "Liz and Jack Szostak" did and then, he describes what they did which was different – which was the opposite. In the prior, they put Tetrahymena telomeres into yeast, but in Greider's experiment, they put yeast telomeres into Tetrahymena. Because they did the exact opposite, the antithesis is a contradictory opposition. It is active but not spatial.				
22	"I would then take the active fractions and subject them to another, different separation step. I used SIZE EXCLUSION, ION EXCHANGE, DYE BINDING, AND HAIRPIN BINDING COLUMNS to successively purify telomerase" (p. 308)	intermediate	Yes	No
This excerpt deals with an antithesis, which is active and entails intermediates. The expressions in small caps describes different methods which are used in order to separate/discriminate a particular, wanted substrate from a mix of many different substrate that varies in many different parameters, such as size for instance of if the substrates are charged. It is however not spatial.				
23 24	"I thought that if I could INACTIVATE[a] the enzyme by specifically cleaving the candidate RNA, I would have strong evidence FOR THE	a. contradictory/ contrary opp. b. contradictory opp.	No	a. Yes (motion, orient.) b. Yes (space)

	INVOLVEMENT OF THIS SPECIFIC RNA IN TELOMERASE ACTIVITY [b]" (p. 311)			
	Antithesis [a] is a contradictory, non-active, opposition. By saying that one could inactivate the enzyme, it implies that it otherwise is active. Inactive/activate thus comprise a contradictory opposition. Meanwhile, how activated an enzyme is could differ – i.e. activity is a gradable quality, and therefore the antithesis could also be a contrary opp. Due to “activity” being both a movement and can be put on a linear scale, it hence belongs to both <i>motion</i> as well as <i>orientation</i> . [b] by accomplishing inactivating the enzyme, Greider concludes that it would give evidence for the involvement of this specific RNA in telomerase activity. Thus, by the contrast of [a], [b] can either be falsified or confirmed – thereby, [b] is too a (non-active) contradictory opposition (either-or-relationship). Since RNA is describes as being “involved” it describes how it relates to the telomerase, it belongs to <i>space</i> .			
25	“That is, DOES TELOMERASE HOLD ON TO THE SUBSTRATE it is elongating for a while, or DOES ONE ENZYME ONLY ADD ONE REPEAT, WITH A SECOND REPEAT added during a second round of binding by a separate enzyme molecule?” (p. 315)	contradictory opp.	Yes	Yes (motion, orient., space)
	This antithetical expression deals with a contradictory, and is active in both cases. It is contradictory because it presents a dualistic relationship – either the telomerase holds on to its molecule for a while, or are there many telomerase which all are adding one piece each and leaves the elongating process once it is done. Because this is some kind of movement, it belongs to <i>motion</i> , and because it describes an event happening inside the cell nucleus (a “container” in the cell but implicit here), it could belong to <i>space</i> . Moreover, since this process entails “elongating”, that is, making something longer, a line of some sort should appear in front of one’s eyes. This abstract line could be warrant to the assumption that the antithesis also could belong to <i>orientation</i> .			

## TELOMERES AND TELOMERASE: THE MEANS TO THE END

The Nobel lecture of Elizabeth H. Blackburn's, was held the same day as Szostak's, 7<sup>th</sup> December 2009<sup>©</sup>. For description of lecture, please see Szostak's lecture.

	Antithesis	Sub-group	Active	Spatial
1	"DNA carries CODING and NONCODING sequences. NONCODING DNA both regulates and ensures the continued inheritance of DNA's CODING information" (p. 257)	contradictory opp.	Yes	No/Yes (motion, orient.)
This active antithesis, appearing twice, describes an either-o-relationship (either a DNA sequence is coding – leading to protein production – or it is not coding – not leading to protein production) and is therefore a contradictory opp. This antithesis does not necessarily have to be interpreted as a spatial conceptual antithesis, meanwhile, if one interprets the coding/noncoding as a movement, it could belong to <i>motion</i> . Also, since sequence of DNA is being describes here, the antithesis could also belong to <i>orientation</i> since DNA often is illustrated as a horizontal structure in space, as are these sequences.				
2	"In the early 1930s McClintock concluded that 'THE NATURAL ENDS' of chromosomes were functionally different from EXPERIMENTALLY-INDUCED or ACCIDENTAL CHROMOSOMAL BREAKS" (p. 259)	contradictory opp./ intermediate	Yes	Yes (orient.)
In this excerpt, there are a contradictory opp. as well as a intermediate It is contradictory since it describes either natural ends or non-natural ends. The non-natural ends are exemplified by experimentally-induced or accidental breaks. Due to that there are more than one possible break that is not natural, it is a intermediate Since this antithesis deals with the ends of DNA, and explicitly is said so, it belongs to <i>orientation</i> since the DNA is interpreted as a vertical structure in space.				
3 4	"A 'STICKINESS' [a] of BROKEN ENDS [b] of chromosomes (causing chromosomal fusions) was one of their defining features while in contrast telomeres, THE NATURAL ENDS [a] of chromosomes, had NO such STICKINESS [b]" (p. 259)	a. contradictory opp. b. contradictory opp./ intermediate	Yes	Yes (motion, orient.)
[a] is an active antithesis which is categorized as a contradictory opposition due to that it consists of an either-or-relationship, i.e. direct opposites, stickiness/no stickiness. The active antithesis [b] deals with a intermediate because "broken" ends could implicate more than one possible option. However, in this context, the ends are categorized as either broken or natural, and therefore [b] is a contradictory opp. too. Both these antitheses belongs to both <i>motion</i> and <i>orientation</i> since, in the case of motion, the "stickiness" is related to chromosomal fusion, and "broken" entails movement, and in the face of orientation, both antitheses deals with the structure of DNA which generally is interpreted as a vertical structure.				
5 6 7	"First, the SEQUENCE and STRUCTURAL FEATURES [a] of telomeric DNA had to be understood. By the early to mid-1970s, VIRAL and BACTERIOPHAGE [b] DNAs, and in some cases their ends, had been studied both BIOCHEMICALLY and GENETICALLY [c]. But what was the end of a CELLULAR [b] DNA in a eukaryotic nucleus –a chromosomal end – like?" (p. 259)	a,c. contradictory opp./ intermediate b. contradictory opp.	Yes	Yes (orient.)
Antithesis [a], consisting of "the sequence of telomeric DNA"/"the structural features of telomeric DNA", is active (as are [b] and [c]). It is a contradictory opp. because it describes two states, place side-by-side in a dichotomous way, but it is also a intermediate Because the telomeric DNA could be describes in more ways as well, apart from its structure and its sequence. Since the antithesis entails DNA structures, it belongs to <i>orientation</i> . Regarding spatiality, the same reasoning applies to [c] as it does here. [b] is a contradictory opposition where virus and bacteria are each other's opposites, an because they entail DNA structure as well, they too belong to <i>orientation</i> . [c] consists of biochemically/genetically, an antithesis which describes in what was DNA can be studied. In this context, these ways are dichotomously put and therefore is a contradictory opp. However, it could be described in more ways, which is why c) also is a intermediate				
8 9	"Thus the typically LONG CHROMOSOMAL DNAs from a CELLULAR [a] nucleus were THOUSANDS OF TIMES	a. contradictory opp. b. contrary opp.	Yes	Yes (orient.)

	LONGER THAN [b] PHAGE [a] DNAs” (p. 260)			
	Antithesis [a] is active and is a contradictory opposition due to that the comparison is taking place between the (in this case) direct opposites of virus and cell. [b] is a contrary opp. which describes the gradable characteristic of how long the chromosomal DNA is. Since both [a] and [b] concerns DNA and since [b] also entails a linear scale, they both belong to <i>orientation</i> .			
10	“the rDNA molecules consisted of two equal halves in a PALINDROMIC arrangement. This made them even more attractive: each telomeric end region would be the same as the other end region!” (p. 260)	contradictory opp.	Yes	Yes (orient.)
	A palindromic arrangement, as is concerned here, is an antithesis in the sense that such structures are each other’s complements, or reflections. A palindrome becomes the same sequence from both ways, such as the name Anna, thus the sequences looks the same, but if opposed to one another, they are each other’s reflections. Since this concerns DNA structure, it belongs to <i>orientation</i> .			
11 12 13	“One experiment done in 1979, radiolabeling the rDNA using just <sup>32</sup> P-LABELED [a] dCTP [b], and UNLABELED [a] dATP [b]. And separating the products by denaturing gel electrophoresis, showed beautiful ladder of tiger stripes EXTENDING UP [c] the gel” (p. 261-62)	a. contradictory opp. b. intermediate c. contrary opp.	a,b. Yes c. No	a,b. Yes (orient.) c. Yes (motion, orient.)
	[a] is a contradictory opp. consisting of either labeled or unlabeled substrates. These substrates, dCTP and dATP – antithesis [b] – is each other’s opposites in this context and since there are also dTTP and dGTP, [b] is a intermediate Both these are active and belong to <i>orientation</i> since the entail DNA structures. [c] describes what the bands on the gel (a method for categorizing, analyzing and separating DNA/RNA or protein) are looking like, and by using “extending up” (an expression which both implies movement as well as a vertical direction, hence <i>motion</i> and <i>orientation</i> ) one also implies that there is something “extending down” – therefore this is a contrary opposition (due to the gradability of up/down). [c] is however non-active, in comparison to [a] and [b].			
14	“Now we know that the essential telomeric sequences are surprisingly SIMILAR among phylogenetically widely DIVERGENT eukaryotes” (p. 262)	contrary/contradictory opp.	Yes	Yes (orient.)
	This active antithesis can both be interpreted as being a contrary and a contradictory opp. It is contrary in the sense that how similar or how different (divergent) two or more objects are, may vary widely. This is therefore a gradable quality, hence a contrary opp. Meanwhile, a particular entity being compared is either different or similar from one perspective. This describes an either-or-relationship, and is therefore a contradictory opp. Due to that the antithesis entails DNA and because of its gradability (linear scale), it belongs to <i>orientation</i> .			
15 16	“First, the telomeric CCCCAA repeat tracts (---) in the ciliates <i>Tetrahymena</i> and <i>Glaucoma</i> were HETEROGENEOUS[a] in length; that is, the DNA molecules in the population carried different numbers of repeats. Perfect DNA replication of PARENTAL [b] DNA to make two DAUGHTER [b] DNAs was NOT PREDICTED to PRODUCE SUCH HETEROGENEITY [a]” (p. 263)	a. contradictory/ contrary opp. b. correlative opp.	Yes	a. Yes (orient.) b. No
	[a] is an active antithesis. It is describing how, in one case, the DNA differs in length and in another case, that it does not (hence contradictory) – at least not to the extent (hence contrary) as between <i>Tetrahymena</i> and <i>Glaucoma</i> (two species). Due to that [a] concerns DNA structure the gradability of the antithetical pair (i.e. that it can be interpreted as a linear scale), it belongs to <i>orientation</i> . [b] describes a relationship between DNA’s – the original (parent) and its copies (the daughters) hence a correlative opp. It is active but not spatial.			
17 18 19	“However, then my lab at Berkeley made SIMILAR[a] observations for other rDNAs and NON-rDNA [b] telomeres of the somatic nucleus, with the DIFFERENCE [a] that in these cases the telomeric DNA sequences were found to be joined to sequences where there was NO INITIAL GGGGTT [c] repeat at all” (p. 263)	a. contrary/ contradictory opp. b,c. contradictory opp.	a,b. Yes c. No	Yes (orient.)
	[a] is a contradictory opp. as well as a contrary one due to the same reasons as described in 14. [b] is only contradictory due to the either-or-relationship (rDNA or non-rDNA) and belongs to <i>orientation</i> since it deals with DNA. [c], in contrast to [a] and [b] is not active. It is contradictory though, since it says “no initial” – meaning that, generally, there is such an initial sequence as GGGGTT repeat.			
20	“TWO TYPES of routes [a] can be envisaged: Telomeric	a. contradictory opp.	a,b. Yes	a,b. (orient.,



21 22	sequences are TRANSPOSED or RECOMBINED [b] onto the developing macronuclear DNA termini, OR THE SIMPLE [c], repeating telomeric sequences are SYNTHESIZED DE NOVO ONTO [b] these termini by specific synthetic machinery” (p. 263)	b. intermediate c. contradictory/ contrary opp.	c. No	motion) c. No/Yes (orient.)
[a] is an active antithesis, allowing only two different types of routes to be discussed (meanwhile, these might be the only two). Due to this dichotomous expression, the antithesis is a contradictory opp. Since routes implicates a road or similar, it belongs to <i>orientation</i> since a road can be illustrated as some kind of direction in space. Because “a route” also involves movement, it also belongs to <i>motion</i> . [b] (active) describes the two different routes “transposed or recombined” and “synthesized de novo” which entail more than two antithesis, which is why it is a intermediate These mechanisms and expressions are describes as movements, and hence the antithesis belongs to <i>motion</i> . Furthermore, since b) deals with DNA structure and how DNA structures might be combined, it also belongs to <i>orientation</i> . [c] is inactive but does indeed depict a contradictory opposition by implying which of the two routes that is the “simple” one – thus, the opposite, in this case “transposed or recombined”, must be difficult, or at least less simple. We cannot know how “less” simple it is – and therefore the antithesis is also a contrary opp. due to this gradability. Because of the gradability, it could belong to <i>orientation</i> even though it might not be obvious.				
23 24	“But in addition, something very interesting always happened to the introduced FOREIGN ( <i>Tetrahymena</i> ) TELOMERE [a] in yeast. We found that YEAST TELOMERIC REPEATS [a] (---) were added to the DISTAL END [b] of the foreign, GGGGTT-repeat telomere after it had been maintained in dividing yeast cells” (p. 264)	a. contradictory opp. b. contrary opp.	a. Yes b. No	Yes (orient.)
[a] is an active antithesis, that consists of “foreign ( <i>Tetrahymena</i> ) telomere“ and “yeast telomeric repeats” – i.e. to different telomeric structures in two different species. Due to this dichotomy, it is a contradictory opp. And because it entails these telomeric DNA structures, the ends, the antithesis belongs to <i>orientation</i> . [b] is not active because only one of the antithesis of the pair is encountered here, namely “distal”. Since distal/proximal is gradable, it hence is a contrary opp. and belongs to <i>orientation</i> (due to the gradability/linear scale, as well as the telomeric structure, a structure of DNA).				
25 26	“Finding a MUTANT [a] implied that there is a gene associated with the ability to heal – a gene that could be mutated to NONFUNCTIONALITY [b]” (p. 265)	contradictory opp.	No	a. No b. No/Yes (motion)
Neither of these antitheses is active, however both are contradictory. [a] is a contradictory opp. in the sense that a mutant differs from a cell, containing DNA that is “normal” without the mutation, concerned here. [b] is contradictory in the sense that something is having a function but later is lacking this a function (an either-or-relationship). [a] is not a spatial conceptual antithesis, [b] however could be since it entails “the ability to heal”, as involved movement and hence, [b] could belong to <i>motion</i> .				
27 28	“a fully functional telomere (‘HEALED END’ in McClintock’s terminology) was generated from a BROKEN chromosome END [a] not just BY CHANCE but rather, by an active, developmentally CONTROLLED process [b]” (p. 265)	a. reverse contrary/ contradictory opp. b. contrary opp.	a. Yes b. Yes/ No	a. Yes (motion) b. No/Yes (orient)
[a] is an active reverse contrary opposition because it (here) deals with a reverse contrary mechanism, making a “healed” telomeric end from a “broken”. Also, because a telomeric end can either be broken or not broken, it is also a contradictory opposition. Since BROKEN/HEALED deal with bringing pieces together or breaking them apart, some kind of movement is included, and therefore the antithesis belongs to <i>motion</i> and is hence a spatial conceptual antithesis. [b] is a contrary opposition, comprising “by chance” and “controlled”. A process can be “very” controlled or “less” so (implied by “by chance” – which makes the antithesis non-active) – it is thus gradable, an abstract linear sale, and therefore belongs to <i>orientation</i> . Moreover, it could also be non-spatial since one has to realize the non-evident antithetical pair, and if one does not, then the antithesis would not be spatial.				
29 30	“This enzyme reaction was MORE EFFICIENT WHEN [a] the extracts were made from cells AT THE DEVELOPMENTAL STAGE [b] when new telomeres are added during macronuclear development” (p. 267)	a. contrary opp. b. contradictory opp./ intermediate	No	a. Yes (orient.) b. No
Antithesis [a] is ranging how efficient the reaction was. This thus concerns a quality of gradability which makes the antithesis a contrary opp. [b] entails “the developmental stage” which of course could imply different stages, as are not being specified here. It is also contradictory opp. because its implied opposite would be a stage that				

does not belong to the developmental one (of <i>Tetrahymena</i> ). Neither antitheses are active. [a] belongs to <i>orientation</i> due to the antithesis's gradability, but [b] is probably not a spatial conceptual antithesis.				
31 32	"Instead, the cells continued TO GROW [a] for only about 20 to 25 more CELL DIVISIONS [b]. During that times their telomeres progressively SHORTENED [a]. The cells then CEASED TO DIVIDE [b]" (p. 271)	a. contrary/ correlative opp. b. contradictory opp.	Yes	a. Yes (motion, orient.) b. Yes (motion)
Both these antitheses are active. [a] comprises on the one hand a contrary opposition, and on the other a correlative opposition. It is contrary in the sense that something is getting bigger (grow – even though it has to do with size), whilst something else is getting smaller (shortened – in length and not size). Therefore one could argue that these antithetical elements do not constitute an antithesis at all, or at least not active. It is correlative in the sense that it establishes a relationship between the cell and its telomeric ends when telomerase is not present. If it grows and divides, then the telomeres are getting shorter and shorter. [b] is a contradictory opposition, consisting of "cell division" and "ceased to divide" – in the first case, the cells are dividing, but in the second, they have stopped doing so. Since [a] comprises a contrary opposition (if accepted) it belongs to <i>orientation</i> (as argued elsewhere for contrary oppositions), and because it also deals with movement (something is growing and something is getting shorter) it hence also belongs to <i>motion</i> . [b] deals with movement as well and therefore belongs to <i>motion</i> .				
33	"The action of telomerase thus could explain how replication of the 5' ends of the chromosomal DNA can be completed, WITHOUT the loss of terminal sequences that would result from normal semi-conservative DNA replication mechanisms" (p. 272)	contradictory opp.	Yes	No/Yes (motion)
This active antithesis in the sense that it describes an event that does NOT include the loss of terminal DNA sequence ("without"), hence a contradictory opp. It is not spatial – only if one interprets "the loss of" as being some kind of movement.				
34	"But the probability of lengthening it by telomerase actually changed depending on the telomere length – the SHORTER the telomere, the more likely it is TO BE LENGTHENED by telomerase action" (p. 273)	contrary/ correlative opp.	Yes	Yes (motion, orient.)
The antithesis above is active. It is a contrary opp. since it deals with the gradable quality of length. Furthermore, it also depict a relationship between the length of the telomere and the likelihood of it getting longer. This relationship makes the antithesis also a correlative opp. Since it entails both a vertical direction and gradability (length) and movement (lengthening and activity) it belongs to <i>orientation</i> and <i>motion</i> .				
35 36	"A general and important corollary concept is that telomeres can exist in two states: CAPPED or UNCAPPED [a]. Capped telomeres signal the cells to KEEP ON PROLIFERATING, all other things being well. But uncapped telomeres in the cell signal the cell; if uncapping is persistent, it signals the cell TO ARREST ITS DIVISIONS [b]" (p. 273)	contradictory opp.	Yes	a. No b. Yes (motion, orient.)
Both [a] and [b] are contradictory oppositions, as well as active antitheses. [a] comprises the direct opposites capped/uncapped, and [b] comprises the direct opposites keep on/arrest. [a] is not spatial, [b] however, does belong to both <i>motion</i> and <i>orientation</i> due to the that this antithesis entail movement, but also because proliferation and divisions implies a growth of the cell in different directions.				
37	"the most striking properties of a telomere is how RESILIENT it can be TO MOLECULAR INSULTS of a variety of types, and then, like the last straw, just ONE MORE MOLECULAR CHANGE is SUFFICIENT for the telomere TO COLLAPSE catastrophically into disaster" (p. 273)	contrary/contradictory opp.	Yes	Yes (motion, orient.)
This antithesis describes a contradictory as well as a contrary opposition. It is contradictory due to "molecular insults of a variety of types" and "just one more molecular change", hence it describes an "all-or-nothing-relationship". Meanwhile it is also a contrary opposition since the antithesis depicts how resilient the telomere is, however, eventually there will be a molecular insult that breaks the camel's back. This way of reasoning – starting from one molecular insult, to two, to three and so on, involves the gradable entity of amount, and hence, the antithesis is contrary. Due to that the antithesis deals with both gradability and movement (change, collapse) it belongs to both <i>orientation</i> as well as <i>motion</i> .				

38 39 40 41	“the telomere in a cell is a HIGHLY DYNAMIC STRUCTURE. Rather than being A ROCK-STABLE COMPLEX [a], it is perhaps reminiscent of a swarm of bees: the SIZE AND SHAPE [b] of the swarm appears THE SAME [c], but in reality ITS COMPOSITION [b] is CONSTANTLY CHANGING [c] as the bees (the telomeric proteins) of the swarm constantly COME OFF [d] it and are REPLACED BY [d]other bees” (p. 273)	a,c. contradictory opp. b. contradictory opp./intermediate d. reverse contrary opp.	Yes	a,c. Yes (motion) b. Yes (space) d. Yes (motion, orient.)
Antitheses [a] and [c] are contradictory opposition, [a] consisting of highly dynamic/rock-stable, and [c] consisting of the same/constantly changing. These two comprise movement and therefore also belong to <i>motion</i> . [b] is a intermediate comprising the size and shape (hence a contradictory opp.) of telomeres. Meanwhile, one could approach the telomere differently as well. Since it depicts a dynamic structure in space (compared to a swarm of bees), it belongs to <i>space</i> . Antithesis [d], consisting of come off/replaced by – a reversible state, is a reverse contrary opposition, which belongs to both <i>motion</i> and <i>orientation</i> since it concerns DNA structure as well as a movement. All antitheses are active.				
42 43	“TETRAHYMENA [a] telomeres in the DISTANTLY RELATED [b] organism baker’s YEAST [a]” (p. 274)	a. contradictory opp. b. contrary opp.	a. Yes b. No	a. No b. Yes (orient.)
Antithesis [a] is a contradictory opposition between the two species <i>Tetrahymena</i> and yeast. It is active but not spatial. Antithesis [b] on the other hand, is not active. It concerns the relatedness of these two different species, and since relatedness is gradable, this antithesis belongs to <i>orientation</i> .				
44	“Telomerase DNA and core protein of telomerase, TERT, each retain WELL-RECOGNIZABLE CONSERVED features in even the most DISTANTLY RELATED eukaryotes” (p. 274)	contradictory opp.	Yes	Yes (orient.)
This antithesis illustrates a correlation concerning the telomerase structure – regardless of how distantly-related species are, they still share some structures that are the same – hence a contradictory opp. Because it entails DNA it belongs to <i>orientation</i> .				
45	“In the face of this WIDESPREAD CONSERVATION of telomeres and telomerase, EXTENDING DOWN to the DEEP roots of eukaryotic evolution, a fascinating finding is THE GREAT VARIETY OF TELOMERE MAINTENANCE stories that play out during the lives of different eukaryotes” (p. 274)	contradictory/ contrary opp.	Yes	Yes (motion, space, orient.)
This antithesis too concerns a correlation between the similarities as well as the differences among species, hence it is a contradictory opp. Meanwhile it is also a contrary opp. because of the expression “extending down to the deep roots”. It is the gradability of this conceptual antithesis down/up ( <i>orientation</i> ) that makes it a contrary opp. It does not just belong to <i>orientation</i> but <i>motion</i> and <i>space</i> as well. Since “extending down” also entails movement (hence motion) and because the relatedness among species (and the expression “roots”) depicts how relatedness among species are interpreted – as in terms of a tree, containing this relatedness (hence <i>space</i> ).				
46	“Humans can have a life expectancy of about EIGHTY YEARS, and laboratory mice about TWO YEARS. Thus, it is reasonable to contemplate the possibility that the rate-limiting steps causing aging and eventual death may differ between these two species” (p. 274)	contrary opp.	Yes	Yes (orient.)
This is an active antithesis which deals with a contrary opp. since age is gradable. Since time (age) can be interpreted as a linear path, a horizontal direction, the antithesis belongs to <i>orientation</i> .				
47	“Even within mammals, the QUALITATIVE and QUANTITATIVE contributions of telomere maintenance to cellular proliferative lifespans seem to differ widely” (p. 274)	contradictory opp.	Yes	No
This is a quite common dichotomous antithesis, hence a contradictory opp. It is active but it is not spatial.				
48	“And, EXTENDING FURTHER OUT from mammals to invertebrates, DESPITE MUCH CONSERVATION of fundamental molecular and cellular mechanisms, it is possible that those mechanisms that contribute to their aging and death from old age may be DIVERGENT FROM those that are quantitatively important or rate-limiting	contradictory/ contrary opp.	Yes	Yes (orient, motion, space)

	for aging and lifespan in humans” (p. 274)			
The same reasoning applies here as for 45.				
49	“One special and notable context in which telomerase plays a prominent role in humans is in human cancer cells. HYPERACTIVE telomerase in the cancer cells is a prominent characteristic of the great majority of most types of malignant human tumors” (p. 275)	contrary opp.	No	Yes (motion)
This antithesis is not active. It however concerns a gradable quality, activity, and therefore it is a contrary opp. Activity entails movement, hence it belongs to <i>motion</i> .				
50	“As described above, abrogating telomerase in OTHERWISE EFFECTIVELY ‘IMMORTAL’ single-celled species causes progressive telomere shortening over several cell generations followed by CESSATION OF CELL DIVISION (‘senescence’)” (p. 275)	contradictory opp.	Yes	Yes (motion)
The active antithesis above is a contradictory opp. since it is describing an ultimatum – either the cell lives “effectively immortal) or it dies (cessation of cell division). Because cell division implicates movement, it belongs to <i>motion</i> .				
51 52	“Second, telomerase activity is not only present in many normal human SOMATIC CELLS [a] but also, importantly, quantifiable in adult (including elderly) humans; even in resting WHITE BLOOD CELLS, as well as in STEM AND PROLIFERATING PROGENITOR CELL TYPES [a], telomerase is active. This means that TELOMERE SHORTENING [b] in normal cell populations has the possibility of being COUNTERBALANCED, or even REVERSE CONTRARYD, throughout life [b]” (p. 276)	a. intermediate b. contrary opp./ intermediate	Yes	a. No b. Yes (motion, orient.)
[a] entails many different cell types, and hence comprise a intermediate [b] however is a contrary opp. due to that shortening entails length which is a gradable quality. Meanwhile, [b] also mentions varieties of how the shortening can be counteracted, and therefore [b] is a intermediate as well. Since it entails both movement and a vertical direction in space, it belongs to <i>motion</i> and <i>orientation</i> .				
53	“While GENETIC influences have been detected, NON-GENETIC factors are also coming to fore as significant influences on telomere length maintenance in human white blood cells” (p. 276)	contradictory opp.	Yes	No
This contradictory opposition, is an active antithesis which comprises the pair genetic/non-genetic. The “non” makes the pair directly oppose to each other. These are not spatial.				

## THE SEARCH FOR INFECTIOUS CAUSES OF HUMAN CANCERS: WHERE AND WHY

Harald Zur Hausen received the Nobel Prize because of his discovery concerning human papilloma viruses which are causing cervical cancer. He had his lecture, 7<sup>th</sup> December 2008<sup>©</sup>.

	Antithesis	Sub-group	Active	Spatial
1	“Because NO human cancer arises as the acute consequence of infection” (p. 225)	contradictory opp.	No	No
This antithesis is not as straight forward as the others are below, but since one discriminates all human cancer from being an acute consequence of infection, one is still creating a contrast. Because “no” is an antithesis to “all” (however not stated here, which is why the antithesis is non-active), this is a contradictory opp. It is not spatial.				
2	“Besides some rare exceptions, NO synthesis of the infectious agents occurs in cancer cells” (p. 225)	contradictory opp.	No	No
The same reasoning applies here as above.				
3	“Mutations in HOST cells or within the VIRAL genome are mandatory for malignant conversion” (p. 225)	Contradictory/correlative opp.	Yes	Yes (space)
The antithesis is active and is a contradictory opposition as well as a correlative one. It is correlative because it depicts a relationship between the virus and the host, and it is contradictory because it deals with either the host cells or the viral ones. In the case of correlative oppositions, it does belong to <i>space</i> because the host acts as a container (not the other way around though).				
4	“CHEMICAL (e.g. aflatoxin) and PHYSICAL carcinogens (e.g. ultraviolet light in Epidermodysplasia verruciformis) usually act as mutagens” (p. 225)	contradictory opp.	Yes	No
This antithesis is categorizing and classifying carcinogens (a substance which can induce cancer) – chemical/physical – and in one sense, this is dichotomy (the division of carcinogens) is an antithesis, a contradictory opposition. Meanwhile, one might wonder whether it also could be interpreted as an intermediate – one cannot be certain of course, however, carcinogens are mostly encountered as being divided into either of these groups. It is an active, but a non-spatial antithesis.				
5 6	“to be caused by REACTIVATED [a] viruses, whose oncogenic potential is usually SUPPRESSED [b] by immunological reactions” (p. 226)	a. contradictory/reverse contrary opp. b. contradictory/contrary/reverse contrary opp.	No	a. Yes (motion, space) b. Yes (motion, orient.)
Both antitheses here are non-active. [a] describes a state which the virus can be found in – either it is (re)active(ated) or it is not. By saying that it is “reactivated” informs us that its prior state was “rest”. Moreover, these antitheses, “active/rest” or “active/non-active”, are contradictory opp. Why is not activated/rest a contrary opp.? Because either the virus is active or it is not. Since [a] depict a movement, it hence belongs to <i>motion</i> . Additionally, if one is familiar with what a virus is and how it stays in the body, one also knows that the cell is its container – therefore, the antithesis could also belong to <i>space</i> . [b] describes a virus’ quality, that its oncogenic potential (the potential of being able to cause cancer), which usually is suppressed. By saying that, one also implies that there is a risk of a virus having a potential that is not suppressed (this does also imply that the quality could be reversible as could [a], therefore, both are also reverse contrary opp.) and hence the antithesis could be a contradictory opp. Meanwhile, how oncogenic a virus is varies, which is why the antithesis is a contrary opp. as well. [b] entails movement (“suppressed”, silent, still), hence belongs to <i>motion</i> , but [b] also entail a gradability, hence the antithesis also belongs to <i>orientation</i> .				
7	“A novel mode of DIRECT viral carcinogenesis (---) The most prominent INDIRECT infectious carcinogens are agents” (p. 227)	contradictory opp.	No	No/Yes (orient.)
Since this antithesis depict an either-or-relationship where the antithesis are each other’s direct opposite, it is a contradictory opp. Meanwhile this pair does not appear in the same nor in parallel sentences which is why it is				

not an active antithesis. Whether it is spatial or not depends on how one interprets the antithetical pair. If one interprets it as I do, like a hand gesture “pointing” at something with the whole hand, going down and up in a vertical direction, the antithesis could belong to <i>orientation</i> . This however is not evident.				
8	“Kaposi’s sarcoma, mainly found in HIV-INFECTED patients, stands out and is found about 200 times more frequently in these patients compared to NON-INFECTED controls” (p. 228)	contradictory opp.	Yes	No/Yes (space)
This active antithesis consists of the direct opposites-pair “infected/non-infected”, hence it is a contradictory opp. It could belong to a sensorimotor domain if one interprets this antithesis as describing a state within which the patients/control group is in (hence <i>space</i> ) but otherwise, it is not a spatial conceptual antithesis.				
9	“Interestingly, the age distribution of HPV-POSITIVE and HPV-NEGATIVE vulvar and penile cancers differs” (p. 228)	contradictory opp.	Yes	No/ Yes (orient.)
This antithesis is of course active, consisting of a contradictory opposition, positive/negative. It is not contrary because in this case, one is either HPV-positive OR HPV-negative. You cannot be both. In this sense, the antithesis is not spatial. However, if the antithesis is approached differently, it could belong to <i>orientation</i> . Due to that something can be regarded as less or more positive or less or more negative, it is gradable and therefore, as all other gradable antithesis, the antithesis belongs to <i>orientation</i> .				
10	“Some cancers DO NOT SHOW an INCREASED incidence during immunosuppression” (p. 229)	contradictory/ contrary opp.	Yes	Yes (orient)
This is a non-active antithesis in the sense that one is describing what some cancers do not, and more specifically, that the cancers cells don’t seem to become more when the immune system is “down” or suppressed. That, however, implies the opposite that some cancer do. Therefore this is a contradictory opp. Since the expression entails the verb and movement “increased” – a quality of gradability – the antithesis is also a contrary opp. Due to its gradability it belongs to, as argued elsewhere, <i>orientation</i> .				
11	“Superantigen INDUCTION in the infected cells leads to reactive T-cell DEPLETION and immunotolerance”(p. 230)	contradictory/correlative opp.	Yes	Yes (motion)
In this active antithesis a correlation is described, where something is introduced, whilst something else is excluded from the picture (hence <i>correlative</i> ), i.e. an either-or-relationship (hence <i>contradictory</i> ). This antithesis illustrates movement and therefore it belongs to <i>motion</i> .				
12 13	“In addition, BREAST CANCER PATIENTS [a], HIV-ASSOCIATED lymphomas, NON-HIV-ASSOCIATED lymphomas and HIV-ASSOCIATED [b] Hodgkin’s lymphomas reveal about seven-fold elevated concentrations of HERV-K (HML-2) RNA in their plasma when COMPARED TO HEALTHY controls [a]” (p. 232)	a. contradictory opp. b. contradictory opp./ intermediate	Yes	No
In antithesis [a], a contradictory opp. is found which consists of patients either suffering from breast cancer or not. Due to this direct opposite, it is contradictory. [b] consists too of such a direct opposite (hence contradictory), meanwhile it also entails <i>different</i> kinds of lymphomas, and therefore [b] is a intermediate as well. Neither of the antitheses are spatial, but both are active.				
14	“The risk of some cancers seems to be influences by other infections which NEITHER DIRECTLY CONTRIBUTE TO CARCINOGENESIS NOR INDUCE LONG-LASTING IMMUNOSUPPRESSION” (p. 232)	contradictory opp./ intermediate	No	No
This is a non-active antithesis in the sense that it describes what infections are not causing cancer, which simultaneously implies that (maybe) all other (not specified, hence intermediate) “qualities” of an infection. Due to this “all-or-nothing-relationship”, it is a contradictory opp. The antithesis might be spatial, but it is not evident and therefore it is categorized as non-spatial.				
15	“a number of HUMAN viruses turn out to be oncogenic when inoculated into newborn rodents (- --) For obvious reasons the reverse contrary question, whether ANIMAL viruses are also able to induce tumors in humans, has not yet been carefully investigated” (p. 234-35)	contradictory/reverse contrary opp./ intermediate	Yes	No
The active antithesis above is a contradictory opp. because of the either-or-division between “human” and “animal”. Meanwhile, “animal” is an expression including all other animals apart from humans, which is why				

the antithesis also is a intermediate Due to that they also mentioned “the reverse contrary question” (which is in relation to “animal viruses”), this antithesis deals with a reverse contrary opp. as well. It is not a spatial antithesis.				
16 17 18	“Correlatively, multiple INFECTIONS [a] during this period emerge as a PROTECTIVE FACTOR [a]. These observations are underlined by correlative data: a HIGH SOCIONOMIC STATE [b] represents a RISK FACTOR [c], whereas CROWDED HOUSE HOLD CONDITIONS [b] and MANY SIBLINGS emerge as PROTECTIVE factors [c]” (p. 236)	a,c. correlative/ contradictory opp. b. contradictory opp.	Yes	a,c. Yes (motion) b. Yes (orient, space)
All antitheses found above are active. [a] and [c] are correlative and contradictory oppositions since: [a] describes an either-or-relationship between infection which would be non-protective, but is in this case. Moreover, because [a] describes this relationship, it is a correlative opp. as well; [c] consists of the antithesis risk factor/protective factor (a contradictory opp.). Since [c] is related to [a] and its relationship between “infections leading to a stronger immune system, and hence acts as protective factors”, it is too a correlative opp. Because these antitheses can be related to movement (protective), they hence belong to <i>motion</i> . [b] is a contradictory opp., consisting of a house hold, either comprising few or many persons. Because the term “high” is being used, [b] belongs to <i>orientation</i> (since high probably is interpreted as a vertical direction in space) , and because “crowded” describes how full a container is (the house is the container), it also belongs to <i>space</i> .				
19	“the FREQUENT OCCURRENCE of specific chromosomal translocations in leukaemic cells, often observed already prenatally. The same types of chromosomal alterations have also been found in healthy individuals, though here their FREQUENCY APPEARS TO BE VERY LOW” (p. 236)	contrary opp.	Yes	Yes (orient.)
This active antithesis, being a contrary opposition, consists of frequent occurrence and frequency appears to be very low. Because this characteristic is gradable, it is hence contrary, and as most other contrary oppositions, presented in this analysis, it belong to <i>orientation</i> .				
20	“Alternatively, Kinlen proposed that sudden mixing of a population of LOW exposure to putative leukaemogenic agent (particularly in rural areas) with another population originating from urban areas previously HIGHLY exposed to the incriminated agent” (p. 236)	contrary opp.	Yes	Yes (orient.)
This is an active antithesis, consisting of the gradable pair low/high. The antithesis belongs to <i>orientation</i> because of at least two reasons – partly because high and low describes a vertical direction, partly because it gradability can be interpreted as a linear scale, a horizontal direction.				

## Appendix 2

Below some pie charts as well as tables are presented, showing how many antitheses that were found in each article, how many that could be categorized as; spatial (orientation, motion, space – or more than one of these), non-spatial or both; whether they were active, non-active or both; whether each antithesis is intermediate contradictory/ contrary/ correlative/ reverse contrary oppositions or more than one of these.

What should be focused on are the pie charts. They present how common the different categories were which is much more interesting since one would like to find out what is more common.

**Table 1.** In this table all lectures are presented and represented by the laureate's first two letters in their last name.

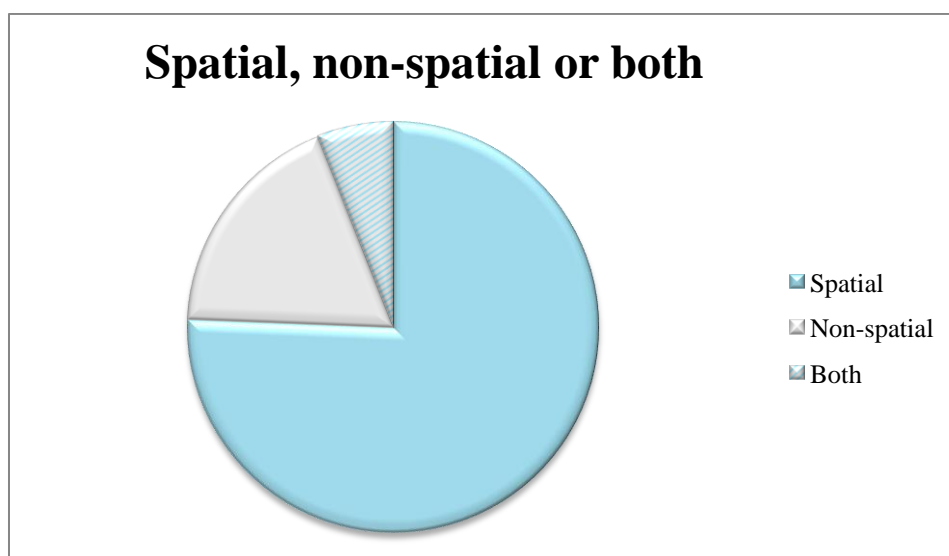
Lecture	Ba	Ho	Be	Ro	Ya	Sü	Sz	Gr	Bl	Ha
<b>Total number of antitheses</b>	28	26	42	38	10	58	36	25	53	20
<b>Spatial</b>	19	25	33	40	7	65	39	25	61	16
<b>Orient.</b>	10	15	11	9	4	27	22	16	36	7
<b>Motion</b>	6	7	15	26	2	26	14	7	22	5
<b>Space</b>	3	3	7	5	1	12	4	2	3	4
<b>Non-spatial</b>	13	5	12	8	5	13	5	4	8	7
<b>Both</b>	1	4	4	3	0	4	0	1	6	3
<b>Active</b>	22	22	33	35	10	47	33	21	42	14
<b>Non-active</b>	5	3	8	2	0	10	2	3	10	6
<b>Both</b>	1	1	1	1	0	1	1	1	1	0
<b>Contradictory</b>	14	20	26	24	5	42	24	19	37	18
<b>Correlative</b>	4	2	5	6	0	5	0	0	3	4
<b>Contrary</b>	9	7	10	2	4	19	11	8	18	4
<b>Reverse</b>	0	0	2	13	0	7	5	1	2	3
<b>contrary</b>										
<b>Intermediate</b>	4	5	10	1	4	9	2	3	10	3



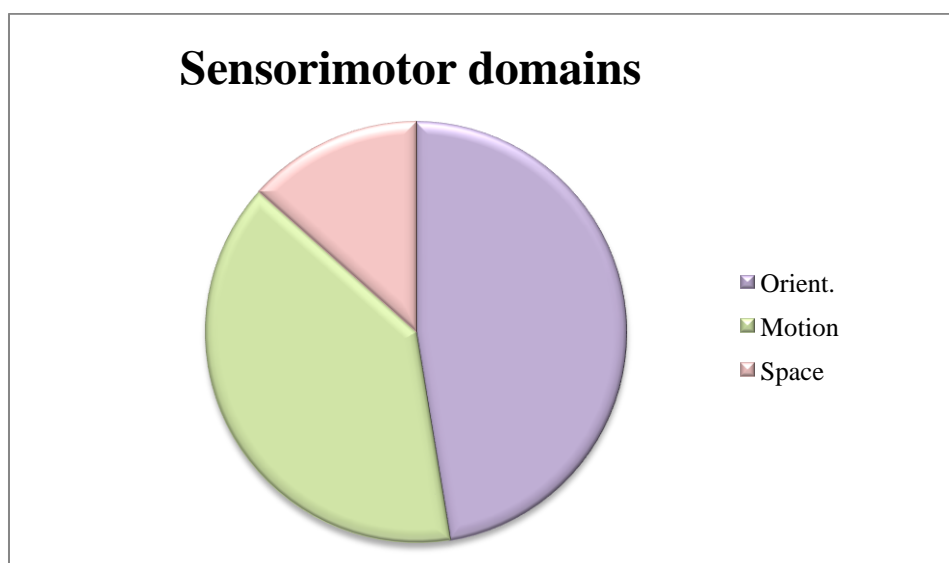
**Table 2.** This table presents the number of all antitheses and their categorization.

**All antitheses and their categorization**

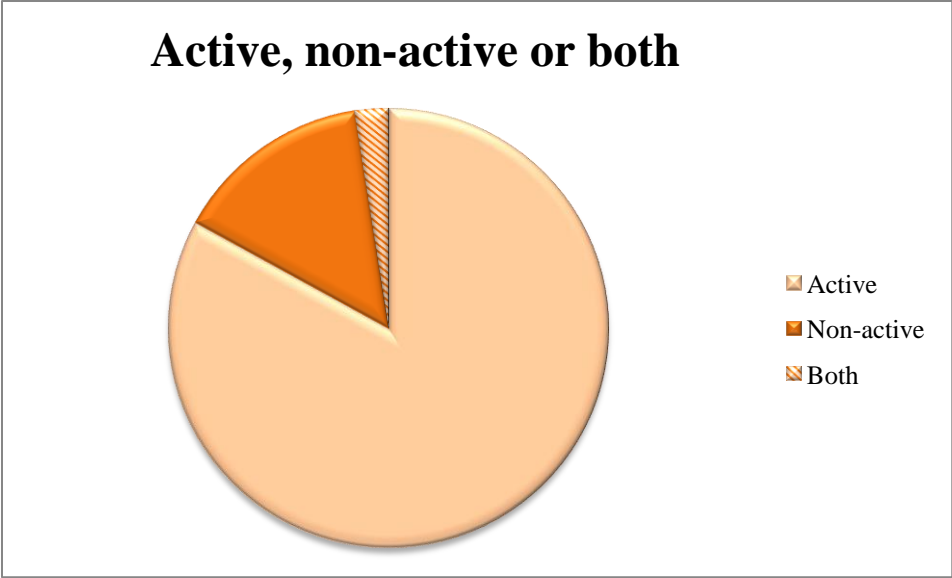
<b>Total number of antitheses</b>	336				
<b>Spatial</b>	330	<b>Active</b>	279	<b>Sub-group</b>	
Orient.	157	<b>Non-active</b>	49	Contradictory	231
Motion	130	<b>Both</b>	8	Correlative	29
Space	44			Reverse contrary	33
<b>Non-spatial</b>	80			Intermediate	51
<b>Both</b>	26			Contrary	92



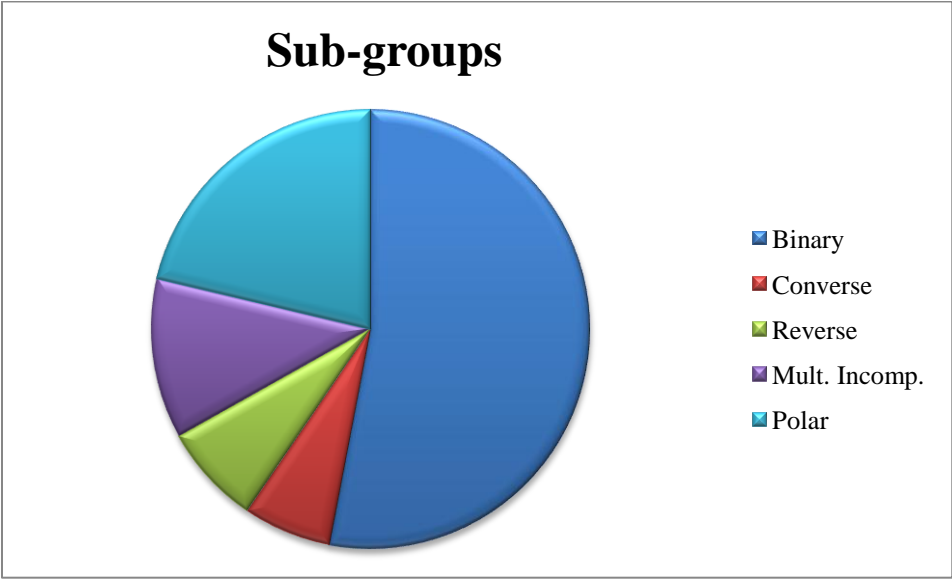
**Figure 1.** This pie chart show how many of the antitheses which were either spatial, non-spatial or both.



**Figure 2.** This figure presents how many of the spatial antitheses which belong to either one or more of the sensorimotor domains.



**Figure 3.** This pie chart shows how many antitheses that were active, non-active or both.



**Figure 4.** This pie chart shows the division of the sub-groups.