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## **Empty Answers in an Experiment of Free Word Association**

### **Abstract**

Empty responses in free word association tests were beyond the scope of research interest in classic experiments. The results of our experiment showed that 6.14% of associations are empty answers. Precise measurement of the time of reaction of each of the participants allowed us to confirm that the empty answer was the result of an intellectual process. An analysis of associations with the stimulus would permit us to segregate those word-stimuli in which the mechanism which generates associations behaves in an atypical manner, thus indicating a difficulty in identifying the meaning of the stimulus, which may then result in a high percentage of empty answers. Yet the significant number of empty responses is not linked with any difficulty in comprehending the stimulus. We may thus conclude that the high number of empty answers in our experiment may depend on the method of conducting the experiment. The participants in the classic experiment were provided with paper forms which contained all of the stimuli in a particular order. Therefore, there was neither a time limit for a single response nor control of the order of stimuli processing. As a consequence, the method allowed backtracking, which means that participants could omit a stimulus without answering and could return to the omitted stimulus later to provide the missing answer. This backtracking possibility may explain the very low number of empty answers in the classic experiment as opposed to our method, which made backtracking impossible.

*Keywords:* free word association, computer assisted experiment, stimulus word comprehension, empty answer.

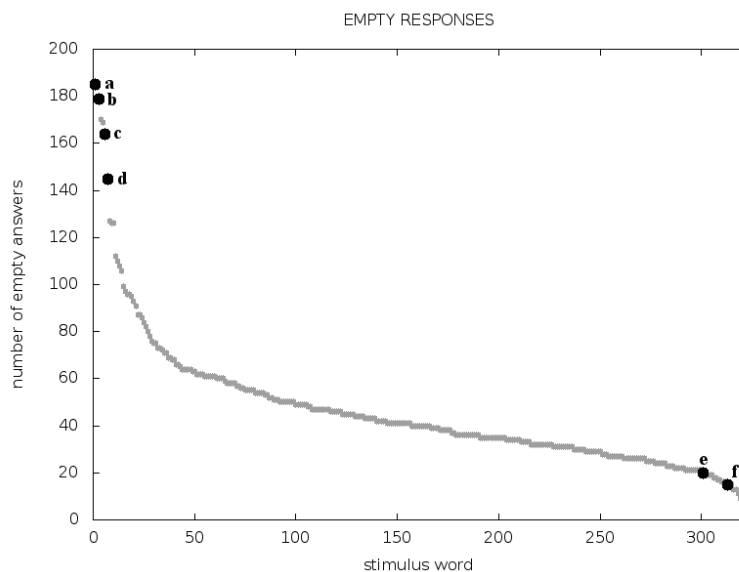
### **Introduction**

A test of word association in which the subject that is being researched gives the first word that comes to his or her mind after hearing the stimulus phrase is a diagnostic method that has been used in psychology for more than 100 years (Kent & Rosanoff 1910). The results of this test also have a linguistic value because

they permit one to research the dependence between linguistic units regardless of the sentence context. It is known (Clark 1970) that the list of responses obtained as a result of this experiment of word association principally contains semantic associations, such as (in Polish) *dom – ściana* (house – wall), seldom seen pragmatic associations, such as *baranina – gangster* (mutton – gangster), and words which have similar sounds, e.g. *dom – tom* (house – volume (*i.e.* book)). There are also empty responses in the experiment results, but these were beyond the scope of research interest and were truncated from the association list, thus we can only find the number of such empty answers by comparing the number of tested subjects, e.g. 100 in the EAT (Edinburgh Associative Thesaurus) and the “total count of all answers,” *i.e.* 95 for the stimulus *home*. In some of the research that was previously conducted the number of empty answers was explicitly shown, as in Kurcz (1967), but no linguistic analysis of the empty response problem has been conducted. We can attempt to analyze the empty answers problem in a modern experiment which allows precise registration of the response time.

### Empty associations in the experiment

This analysis is based on the results of an experiment in which 750 people responded to 322 stimuli (Gatkowska *et al.* 2013; Gatkowska 2014). The tested subjects were provided stimuli-words that were subsequently presented on a computer monitor and they had five seconds to react, *i.e.* to start typing in an answer – the pressing of any key, except for the [Enter] key, was regarded as typing. If they did not start typing, an empty answer was recorded; if they did start typing, the time was recorded until they pressed the [Enter] key. Each tested subject had his or her own monitor, but the stimuli set and stimuli order were the same for each participant of the test.



Where: a – *pełna* ‘unfulfilled,’ b – *bielinek* ‘brimstone butterfly,’ c – *wieku* ‘age (gen.),’ d – *kwiecie* ‘blossom,’ e – *woda* ‘water,’ f – *łóżko* ‘bed’

Figure 1. Number of empty answers per stimulus word

The results of the experiment show that 6.14% of the 241 257 associations are empty answers. Figure 1 shows that there is a relatively small set of stimuli-words which collected an extremely high percentage of empty answers. These are: *pełonna* 'unfulfilled' – 24.5%, *zawodna* 'unreliable' – 24.17%, *bielinek* 'brimstone butterfly' – 24.7%, *wieku* 'age (genitive case)' – 21%, *kwiecie* 'blossoming flowers' – 18.4%, *wisząca* 'hanging' – 16.07%, *duża* 'big (fem. form)' – 15.94%, *duży* 'big (masc. form)' – 14.1%, and *spokojny* 'peaceful' – 14.1%. But there is also an opposite set of stimuli with a very low number of empty responses: *woda* 'water,' *świecić* 'to light,' *drewniany* 'wooden,' *korona* 'crown,' *rodzinny* 'family,' *tron* 'throne,' *śpiew* 'singing,' *władca* 'ruler,' *zielona* 'green (fem. form),' *papieros* 'cigarette,' *łóżko* 'bed,' and *orzeł* 'eagle.' Each stimulus has an empty responses number below 2.7% of the total answers.

### Response time analysis

In the psycholinguistic tradition, the quality of an answer given to a stimulus is related to the response time – a response time that is too short might produce sound similarity (clang and rhyme) responses, but one that is too long might produce sophisticated associations that are distant to the meaning of the stimuli (Clark 1970). Therefore, we shall compare the reaction times which led to an empty response for stimuli of both the highest and the lowest percentages of empty responses.

Table 1 presents the reaction time for empty answers associated with the stimuli of the highest percentage of empty answers.

Table 1. Empty answers reaction time in seconds

Stimulus	Empty answers	< 1 sec	1–5 sec	> 5 sec
pełonna 'unfulfilled'	185	16	112	57
zawodna 'unreliable'	184	8	84	92
bielinek 'butterfly'	179	20	96	63
wieku 'age (gen.)'	164	6	68	90
kwiecie 'blossom'	145	8	72	65
wisząca 'hanging'	127	2	61	64
duża 'big (fem.)'	126	0	62	64
spokojny 'peaceful'	112	2	48	62
duży 'big (masc.)'	108	2	45	61

Precise measurement of the time of each reaction of every subject researched here allowed us to confirm that a response which took less than one second comprised barely 1% of the empty answers, therefore, an empty answer is the result of an intellectual process which lasts more than one second; some of the responses, in fact, lasted longer than ten seconds.

The same tendency can be observed in reactions to those stimuli which obtained the smallest number of empty answers. Table 2 shows the results:

Table 2. Empty answers reaction time in seconds

Stimulus	Empty answers	< 1 sec	1–5 sec	> 5 sec
woda 'water'	20	2	11	7
świecić 'to light'	19	0	10	9
drewniany 'wooden'	19	3	5	11
korona 'crown'	19	5	7	7
rodzinny 'family'	18	5	4	9
tron 'throne'	18	7	2	9
śpiew 'singing'	17	0	7	10
władca 'ruler'	17	8	3	6
zielona 'green'	16	3	6	7
papieros 'cigarette'	16	5	6	5
łóżko 'bed'	15	0	4	11
orzeł 'eagle'	15	3	5	7

We could therefore infer that there is no reaction time which is specific to an empty answer. In other words, an analysis of the reaction time does not explain the mechanism of providing an empty answer. This means that we must look for a linguistic explanation of this phenomenon.

### Analysis of the stimuli

If we look at the stimuli that collected the highest number of empty answers, we can find that it is difficult to find any grammatical or semantic features that all of these words share:

- *płonny* 'unfulfilled, not carried out or brought to completion' – an adjective which does not have a morphological relation in the contemporary Polish language; in the dictionaries it is only noted as a component of the idiomatic expression *płonna nadzieja* 'unfulfilled hope';
- *zawodny* 'unreliable' – an adjective derived from the perfective verb *zawieść* 'to fail', which has a restricted set of morphological relations;
- *bielinek* 'brimstone butterfly' – a noun which is a regular derivative of the adjective *biały* 'white';
- *wieku* 'age (gen.)' – a noun which has two meanings: 'human age' or 'period of time.' Both meanings enter into a rather rich set of morphological relations; the genitive form of age *wieku* may serve as a component of a few idioms, e.g. *w kwiecie wieku* 'mature' or *w sile wieku* 'mature';
- *kwiecie* 'blossoming flowers' – a collective noun, 'blossom,' belonging to the rare class of singulare tantum, is itself a derivative from the noun *kwiat*, 'flower'; it may serve as a component of the idiom *w kwiecie wieku* 'mature';
- *wisząca* 'hanging' – the active (present) participle of the verb *wiszieć* 'to hang';
- *duża* and *duży* are, respectively, the feminine and masculine form of the adjective 'big,' with a very limited set of morphological relations;
- *spokojny* 'peaceful' – an adjective with limited morphological relations.

This means that we must look at the association sets and recognize if an empty answer depends on the meaning of the stimulus. If it does, then a high percentage of empty answers may signal a difficulty in understanding the stimulus, but in order to prove this hypothesis we must perform a qualitative analysis of the responses which co-occur with a high number of empty responses.

### Analysis of associations

In order to analyze associations we may accept what Clark (1970) stated – that the person who is the subject of a test employs a mechanism of his or her own association which we may observe in word association games. This mechanism functions in three phases: understanding the stimulus (identification of the meaning), operating on the meaning, and providing an answer.

An analysis of associations with stimulus words as mentioned above would permit us to segregate those situations in which the mechanism which generates associations behaved in an atypical fashion and which may then have resulted in a high percentage of empty answers.

As was mentioned earlier, the psycholinguistic tradition distinguishes three types of associations:

- semantic associations, where the dependency between a stimulus and a response may be explained by a semantic relation, e.g. the association *roof* – *house* is explained as ‘*roof* part of *house*.’ We assume that for our analysis there is no need to distinguish between paradigmatic, e.g. *dach* – *dom* (roof – house), syntagmatic, e.g. *duża* – *wieża* (big – tower) and causal *uderzenie* – *rana* (hit – wound) relations, but we must distinguish well-known (Clark 1970) idiom completion associations such as *kwiecie* – *wieku* or *kwiecie* – *wiek* (blossom – age), which is the association between the components of an idiom or a multi-part word; in our example: *w kwiecie wieku* ‘mature’;
- clang and rhyme associations, where there is no relation between the meaning of a stimulus and the meaning of a response; this association is based on sound similarity, which means that the association word sounds similar to the stimulus word, e.g. *dom* – *tom* (house – volume, i.e. book);
- pragmatic associations such as *baranina* – *gangster* (mutton – gangster), which can be explained on the basis of knowledge.

We shall use the criteria as described above to classify all associations given to those words which collected the highest number of empty associations.

**Semantic associations.** Each stimulus word has a large number of semantic associations, therefore, we shall present only the most frequent examples, accordingly to the number of empty associations: *bielinek* ‘brimstone butterfly’ associates with: *motyl* ‘butterfly’, *owad* ‘insect’, *cytrynek* ‘kind of butterfly’, and *kapustnik*, a component of *bielinek kapustnik* ‘official name of the brimstone butterfly’; *pełna* ‘unfulfilled’ associates with: *nadzieja*, *nadzieje* ‘singular and plural of hope’, which completes the idiom *pełna nadzieje* ‘unfulfilled hope’; *zawodna* ‘unreliable (fem.)’ associates with: *pamięć* ‘memory’, *rada* ‘advice’, *broń* ‘weapon’; *wieku* ‘age (gen.)’ associates with: *schyłek* ‘fall of’, *lata* ‘years’, *starość* ‘elderliness’; *kwiecie* ‘blossoming flowers’ associates with: *łąka* ‘meadow’, *ogród* ‘garden’, *wiosna* ‘spring’ and *wieku* ‘age (gen.)’, which completes the idiom: *w kwiecie wieku* ‘mature’; *wisząca* ‘hanging’ associates with: *lampa* ‘lamp’, *skała* ‘rock’, *lina* ‘rope’; *duża* and *duży* ‘big (fem./masc.)’ associates with: *mała/mały* ‘small (fem./masc.)’;

*dziura* 'hole,' *głowa* 'head,' *dom* 'house'; *spokojny* 'peaceful' associates with: *człowiek* 'human being,' *cichy* 'silent,' *morze* 'sea.'

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**Shifted semantic associations.** The listing presented above does not make the analysis of semantic associations a complete one. We can observe that there are responses on the association list in which the meaning does not enter into a semantic relation with the meaning of the stimulus, but we can *explain* the association through morphological relations which help us to find a word that is based on the same root as the stimulus word and that enters into a semantic relation with the response; for example, the association *bielinek* – *bielik* ('brimstone butterfly' – 'sea eagle') may be explained by the operation chain, which is based on the altering root *biel*: *biał* 'white': *biel-inek* 'butterfly' → *biał-y* 'white' → *bielik* 'eagle.' We can state that a morphologically related word, *biały*, mediates this association. A similar mediation occurs in the association *bielinek* – *czarny* ('brimstone butterfly' – 'black'): *biel-inek* 'butterfly' → *biał-y* 'white' → *czarny* 'black', where 'white' and 'black' are antonyms. If the stimulus word does not enter into morphological relations in contemporary Polish, the association can be based on a sound form similarity which enables a substitution of the stimulus, then the meaning of the substitute enters into a semantic relation with the response; for example, the association *płonna* – *mowa* ('unfulfilled' – 'speech') is based on the sound form similarity *płonna*: *płynna* ('unfulfilled' : 'fluent'), where both forms differ by a single vowel *o*: *y*, then the meaning of the substitute *płynna* 'fluent' enters into a relation with *mowa* 'speech.' Sound similarity between a stimulus and its substitute suggested by an answer may be even weaker, e.g. the association *płonna* – *czupryna* ('unfulfilled' – 'pelt, hair') suggests the substitution *płonna*: *płowa* ('unfulfilled' : 'flaxen'), where the stimulus and its substitute differ by the consonant sequence *nn*: *w*, then the meaning of the response *czupryna* 'pelt, hair' enters into a syntagmatic relation with the meaning of the substitute *płowa* 'flaxen.' We shall call this type of semantic association a **shifted** one.

Shifted semantic associations are specific only to *bielinek*, *wieku*, *kwiecie*, *płonna* and *zawodna*. Here are some examples:

- *bielinek* 'brimstone butterfly' has associations mediated by *biały* 'white': *bielinek* – *biały* ('butterfly' – 'white'), *bielinek* – *biel* ('butterfly' – 'whiteness'), *bielinek* – *bielik* ('butterfly' – 'eagle'), *bielinek* – *czarny* ('butterfly' – 'black');
- *kwiecie* 'blossoming flowers' has associations mediated by *kwiat* 'flower': *kwiecie* – *łodyga* ('blossoming flowers' – 'stem'), *kwiecie* – *liść* ('blossoming flowers' – 'leaf'), *kwiecie* – *owoc* ('blossoming flowers' – 'fruit');
- *wieku* 'age (gen.)' has associations mediated by *wiek* 'period of time': *wieku* – *wiekuista* ('age' – 'over time'), *wieku* – *wiekowy* ('age' – 'elderly'), *wieku* – *historia* ('age' – 'history'), *wieku* – *szmat* the idiom completion for *szmat czasu* ('very long time');
- *zawodna* 'unreliable' has associations mediated by *zawieść* 'to fail and not match expectations': *zawodna* – *kobieta* ('unreliable' – 'woman'), *zawodna* – *rada* ('unreliable' – 'advice'), *zawodna* – *przyjaźń* ('unreliable' – 'friendship');
- *płonna* 'unfulfilled' has associations mediated by form similarity: *płonna* – *czupryna* ('unfulfilled' – 'pelt, hair'), substitution *płonna*: *płowa* ('unfulfilled' : 'flaxen'), supposed association *płowa* – *czupryna* ('flaxen' – 'pelt, hair'); *płonna* – *włosy* ('unfulfilled' – 'hair'), substitution *płonna*: *płowa* ('unfulfilled' : 'flaxen'), supposed association *płowa* – *włosy* ('flaxen' – 'hair'); *płonna* – *sukienka* ('unfulfilled' – 'shirt'), substitution *płonna*: *spłowiata* ('unfulfilled' : 'faded'), supposed association *spłowiata* – *sukienka* ('faded' – 'shirt'); *płonna* –

*kobieta* ('unfulfilled' – 'woman'), substitution *płonna* : *płocha* ('unfulfilled' : 'coltish'), supposed association *płocha* – *kobieta* ('coltish' – 'woman'); *płonna* – *świeca* ('unfulfilled' – 'candle'), substitution *płonna* : *płonąca* ('unfulfilled' : 'burning'), supposed association *płonąca* – *świeca* ('burning' – 'candle'); *płonna* – *mowa* ('unfulfilled' – 'speech'), substitution *płonna* : *płynna* ('unfulfilled' : 'fluent'), supposed association *płynna* – *mowa* ('fluent' – 'speech').

**Clang and rhyme associations.** We can find this type of association only for some stimuli. Because the clang and rhyme associations are based on a non-semantic sound similarity, we shall not translate any examples:

- *bielinek* 'brimstone butterfly' – *okrąglinek*, *walinek murzynek*;
- *płonny* 'unfulfilled' – *wonna*, *wanna*, *chłonna*, *blona*, *Anna*;
- *wieku* 'age (gen.)' – *człeku*, *człowieku*, *leku*, *powieka*;
- *kwiecie* 'blossoming flowers' – *plecie*, *świecie*, *dziecię*.

**Pragmatic associations.** This type of association is not frequent and depends on the meaning of the stimuli. We can state that only these two stimuli have a meaningful number of such associations; this means *wieku* 'age (gen.)', e.g. *wieku* – *uniwersytet* ('age' – 'university'), where the association completes the thought *uniwersytet trzeciego wieku* 'university for seniors' and *spokojny* 'peaceful', e.g. *spokojny* – *ocean* ('peaceful' – 'ocean'), which completes *Ocean Spokojny* 'the Pacific Ocean'.

Finally, we can observe two additional answer types. The so-called **don't know** answer – where a response explicitly suggests that the tested person is unable to understand the meaning of the stimulus word, e.g. *bielinek* – *co to?* 'no guess.' The second type is the so-called **random** answer, which means that we cannot apply any of the rules listed above to find a dependency between a stimulus and a response, e.g. *kwiecie* – *daleko* ('blossoming flowers' – 'far away'), *kwiecie* – *jeszcze* ('blossoming flowers' – 'still').

Now we can sum up the results of the analysis, which is shown in Table 3 below:

Table 3. Association classes and empty answers

Word	Association						
	Empty	Semantic	Shifted	Clang and rhyme	Pragmatic	Don't know	Random
<i>bielinek</i> 'brimstone butterfly'	24.7	36.3	32.8	0.04	0	6.1	0.06
<i>płonna</i> 'unfulfilled'	24.5	51.8	14.1	1.3	0	1	7.3
<i>zawodna</i> 'unreliable'	24.17	53	0.07	0.01	0.04	0.03	22.68
<i>wieku</i> 'age (gen.)'	21	44	6.31	0.05	24.07	0.07	4.5
<i>kwiecie</i> 'blossom'	18.4	49	14	13.1	0.15	0.15	5.2
<i>wisząca</i> 'hanging'	16.07	78.19	0	0	0.01	0.03	5.7
<i>duża</i> 'big (fem.)'	15.94	83.98	0.01	0	0	0	0.07
<i>duży</i> 'big (masc.)'	14.1	85.74	0	0	0.09	0	0.07
<i>spokojny</i> 'peaceful'	14.1	77.68	0	0	4.22	0	4

The goal of this analysis was to find those situations in which the mechanism which generates the associations behaves in an atypical fashion, which may then result in a high percentage of empty

answers. And, in fact, there are stimuli (*płonna, bielinek, kwiecie, wieku*) which have a relatively small number of semantic associations (*i.e.* less than 50% of the answers provided, except for *płonna* – 51.8%), there are many shifted associations in the responses (32.8% – *bielinek* ‘brimstone butterfly’, 14% – *kwiecie* ‘blossoming flowers’, 14.1% – *płonna* ‘unfulfilled’ and 6.31% – *wieku* ‘age (gen.)’), and a relatively high number of associations going back directly to the audio forms of stimuli, *i.e.* the so-called clang and rhyme responses, respectively, 1.3% for *płonna* ‘unfulfilled’ and 13.1% for *kwiecie* ‘blossoming flowers.’ We can state that these figures describe an atypical association model because the remaining stimulus words with a high number of empty responses, *i.e.* adjectives such as: *zawodna* ‘unreliable’, *wisząca* ‘hanging’, *duża* ‘big (fem.)’, *duży* ‘big (masc.)’, *spokojny* ‘peaceful’, have answers which are almost always correct semantic associations, *i.e.* they are able to be clarified through the aid of syntagmatic and paradigmatic relations, as well as rare onomatopoeic (clang and rhyme) and pragmatic associations. In other words, the remaining stimuli, with a high number of empty responses, have an association model that is the same as those stimuli which collected a low number of empty answers, *e.g.* *kwiat* ‘flower’ (76.51% semantic, 0% shifted, 0.36% clang and rhyme, 2.77% empty), and a very low number of empty answers, *e.g.* *łóżko* ‘bed’ (94.5% semantic, 0% shifted, 0% clang and rhyme, 0.18% empty), or *orzeł* ‘eagle’ (56.43% semantic, 0% shifted, 0.45% clang and rhyme, 0.17% empty, and 39.53% pragmatic associations which are based on stimulus comprehension). Therefore, the significant number of empty responses is not linked with a difficulty in comprehension of a stimulus, thus we must search for its true cause.

We may thus conclude that the number of empty associations in our experiment may depend on the method of conducting the experiment. The participants in the classic experiment (Kurcz 1967; Kiss *et al.* 1973) were provided with paper forms which contained all of the stimuli in a particular order. Therefore, there was neither a time limit for a single response nor control of the order of stimuli processing. As a consequence, the classic method allowed backtracking, which means that the experiment’s participants could omit a stimulus without answering and could return to the omitted stimulus later to provide an answer. This backtracking possibility may explain the very low number of empty answers in Kurcz’s experiment as opposed to our experiment, which made backtracking impossible. Finally, Kurcz’s participants were provided with only 100 stimuli, as opposed to the 322 stimuli provided in our experiment.

Finally, we have to explain what the model of associations given to *płonna, bielinek, kwiecie* and *wieku* means. We may suppose that the low percentage of semantic associations combined with the large percentage of shifted associations and the relatively high number of clang and rhyme responses may show a difficulty in comprehension of the stimulus. To prove that this association model does not depend on the method used to conduct the experiment, we compared the associations with *kwiecie* ‘blossoming flowers’ that we obtained in our experiment (IG) and in Kurcz’s experiment (IK). For control purposes, we used the associations with *kwiat* ‘flower’ that we obtained in our experiment. The results of our comparison are presented in Table 4.

Table 4. *Kwiecie* in different word association experiments

Word	Semantic	Shifted	Clang and rhyme	Pragmatic	Empty	Don't know	Random
<i>kwiecie</i> (IG) ‘blossoming flowers’	49	14	13.1	0.15	18.4	0.15	5.2



Word	Semantic	Shifted	Clang and rhyme	Pragmatic	Empty	Don't know	Random
kwiecie (IK) 'blossoming flowers'	62.6	17.6	1.31	13.3	0.04	0	5.15
kwiat (IG) 'flower'	76.51	0	0.36	19.28	2.77	0.12	0.96

As can be observed, *kwiecie* 'blossoming flowers' in Kurcz's experiment has more semantic associations and, surprisingly, more shifted associations (17.6%) than *kwiecie* 'blossoming flowers' did in our experiment (14%). The clang and rhyme responses also differ, but Kurcz's result is substantially lower (0.15%) than ours (13.3%). Therefore, one may conclude that the high number of shifted semantic associations truly shows a difficulty in stimulus comprehension, and the high number of clang and rhyme associations only confirm this conclusion. Hence, the high percentage of empty answers may only reflect this difficulty in stimulus word comprehension.

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