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Empirical and Social Anxiety about the Covid-19 Pandemic: Measurement, Diagnosis, Modelling

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Abstract The article contains the results of a survey conducted among students of two higher education institutions: University of Bielsko-Biała (ATH) and Cavalry Captain Witold Pilecki State University of Małopolska in Oświęcim (MUP). The study utilises the achievements of economics and sociology in the field of behavioural modelling through the public communication ecosystem. Based on the R. Dunbar's social brain model and D. Kahneman's dual-system theory, a new model of attitude measurement was introduced. The model was used to determine the empirical level of anxiety about the Sars-CoV-2 virus. The diagnostic purpose of the study required the operational definition of such research categories as: baseline anxiety, empirical anxiety, social anxiety, modelled sample range, baseline mortality rate, and empirical mortality rate. The scale and base parameters for the studied phenomenon were established on the basis of the official statistical data on Covid-19 mortality in Poland. The results of the study indicate a significant difference in the perception of the primary pandemic risk; the primary picture of risk (empirically observed mortality rate) turned out to be 57 times lower than the secondary picture of risk (official mortality rate). The conclusions of the study illustrate the phenomenon of communication dissonance and behavioural modelling during the Covid-19 pandemic.

Keywords: Covid-19 in Poland, Dunbar's number, empirical anxiety, social anxiety, behavioural modelling, ecosystems of communication

INTRODUCTION

The Covid-19 pandemic initiated crucial changes at every level of socio-economic life. The first two months of the pandemic paralyzed elementary functional systems, and citizens in several countries assumed the attitudes of mere observers of events, thus losing their subjectivity. Attitudes towards social reality began to diversify over time; in autumn 2021, protests and riots of various intensity began in many countries. The need for survival and individually experienced cognitive dissonance, triggered by explanatory narratives, increased the demand for data, opinions and comments allowing for the assessment of the epidemic risk. The aforementioned data were of fundamental importance, as – especially at the beginning of the pandemic – they had a direct and immediate impact on people's behaviour (Paprocki 2020 p. 42). Information got through to individuals within two information ecosystems: the private one, enabling the exchange of environmental experiences, and the public one, created by public and private media (Wróblewska-Jachna 2022).

Observations of the behaviour of various social groups indicated a significant diversity of environmental-based assessments of the pandemic risk. The main task of the researchers was to find the answer to the following question – what adaptation mechanisms caused such different attitudes? The adopted research hypothesis was: **the Covid-19 pandemic, through mutually competitive information ecosystems, induced significantly different levels of social anxiety and empirical anxiety about the pandemic threat.**

COGNITIVE DISORIENTATION AND ITS SOURCES

Communication narratives allow for rooting in social worlds, they are the material of the relational capital available to individuals. The validation of the existing reality takes place in the conversations of people who exchange content related to religion, morality, law, customs, and cultural traditions (Świątkiewicz 1993, p. 7–11). The social system is created by individuals that legitimize the available patterns of action through daily repeated activities resulting from the social roles or common axionormative system. The basis for the construction of social worlds is therefore meeting and dialogue, and the self–organization of society takes place in the process of assigning meanings. Taking communication process into account, ideas arise that are subject to affirmative development or rejection, ideas are the material of the process of institutionalization of specific norms, as well as operating practices. The social world is consolidated by the trust of recipients towards the institution, as well as towards the transmitted content. The generational reproduction of social worlds is carried out through

stable elements of institutional infrastructure that maintains a specific order. In this process, it is necessary to build objectified knowledge about reality. One of its elements is the communication ecosystem within which public institutions provide and exchange information that helps to maintain social ties (Dobek-Ostrowska, Wiszniowski 2001 p. 18). Communicating the content and the very form of communication can also lead to social disintegration, and the instability of public communication entails the disintegration of the entire social system. The violation of cultural forms related to communication paves the way to the recomposition of social structures, since cause-and-effect relationships between actions and communication processes are inseparable. The interruption of the reproduction of the axionormative system opens the way to social innovations (Wróblewska-Jachna 2021).

During the Covid-19 pandemic, as public expectation of data increased, inconsistencies in communication systems emerged regarding, among other things, the number of the infected, assessment of the effectiveness of counter-actions taken and the scale of the threat, whereas the inability to verify the information provided gave rise to cognitive uncertainty. A global phenomenon accompanying the pandemic became *infodemic* associated with massive public disinformation, and its scale significantly damaged trust in social institutions[1]. The measures taken by many governments to contain infodemic proved disproportionate to the scale of the threat. Conflicting messages, operating in the public information ecosystem, have contributed to the development of numerous conspiracy theories, false reports about medicines, vaccines and the consequences of the restrictions. In order to prevent panic, and to eliminate false information**,** censorship emerged in various communication ecosystems (Marsili 2020 p. 147–170). Thus intensified cognitive disorientation induced a state of anxiety, as the lack of access to reliable information results in decision paralysis and ability to understand the situation, as well as hindered adaptation to the outside world. A sphere of public communication saturated with interpretations rather than facts induced a sense of being manipulated by broadcasters (Rembierz 2021 p. 134–146).

ANXIETY AND MORAL PANIC VS MEDIA ECOSYSTEMS

A situation of increasing threat creates a feeling of fear, which can develop into anxiety, i.e. an unpleasant, long-lasting emotional state connected with the feeling of tension and anticipation of danger coming from the outside or from within the organism (Gerrig, Zimbardo 2009). Unlike fear, anxiety can be long-lasting and incapacitating, causing feelings of tension, restraint and threat. The primary function of anxiety is to warn of danger, and at least two types of anxiety can be distinguished:

– realistic anxiety, which is the fear of a real threat in the external world and its severity is proportional to the severity of the fear,
– moral anxiety, i.e. fear of one's own conscience causing feelings of guilt or shame**.**

When anxiety is constantly present in our behaviour**,** it becomes pathological and consequently leads to disorders.

Propaganda and disinformation activities induce and fuel fear facilitating decision-makers to achieve specific economic, political or military objectives. Actors in the media ecosystem can manage fear by inciting a 'moral panic'. The concept of 'moral panic' was introduced by Stanley Cohen (Cohen 2002) while researching the British media in the 1970s, where he observed a process of stigmatisation of youth subcultures members. Media messages created an atmosphere of resentment, fear and distrust of youth and consequently shaped public opinion and, in the long term, influenced political and social behaviour.

The fear management strategy consists of three consecutive or parallel stages:
– the first stage is the construction of messages that introduce and sustain the state of threat; a fundamental role is played by the widely understood traditional media and social media, intensive propaganda and disinformation activities exaggerate the threat, the aim is to create a state of moral panic and create public consent for certain political actions that may restrict democratic principles, civil rights and freedoms,
– the second stage is what is known as 'offering a remedy', i.e. introducing into the narrative a vision of the tools and strategies for solving the problem, the proposed solution is understandable to a wide audience based on an 'either-or' alternative, the communication activities are aimed at convincing the community that the only available salvation for the community is to comply with the proposed solutions or actions;
– in the third stage, there is a permanent anchoring of the fear narrative in the media and the creation of the so-called resonance and echo chamber effect in social media reinforcing the message and influencing its longevity in various forms: rumour, factoid, stereotype or area of social stigmatisation; the following actions are intended to create a moral panic that more or less consciously increases the range of support for the proclaimed theses (Pietrzak 2017).

Moral panics mostly concern fundamental issues touching on axiological values and lead to a polarised society. Social divisions influence greater public involvement and the emergence of more stakeholders, creating pressure for change. Fear management makes it possible to push through solutions that, in a time not influenced by panic, would not have a chance to succeed or would trigger public resistance (Strupiechowska 2019).

The narrow but very spectacular tools of the "fear management" strategy also include a number of specific mechanisms, such as: rationalisation, positing cause-effect relationships, describing social phenomena in highly simplified language using generalisation and stereotyping, using symbolic language derived from the traditions and culture of a given collective, referring to specific "fears" in the historical and cultural context of the intimidated collective, describing reality on the basis of a simplified vision of the world, often based on conspiracy theories with a clear division between 'good' and 'evil', avoiding the description of threats in individual categories, using collective categories - 'us', 'them', using the figure of the 'scapegoat', using metaphors associated with natural disasters and apocalyptic visions in narratives describing threats (Bak 2020).

The public communication ecosystem is used by various social actors in terms of behavioural modelling of audiences (Paprocki 2020). During the Covid-19 pandemic, it operated according to a 'fear management' model, with private and public broadcasters sharing channels with broadcasters introducing inconsistent or false messages. An issue of interest to the authors of the study was how a private communication ecosystem functioned during the Covid-19 pandemic, within which individuals build personal knowledge of events and develop survival strategies based on this knowledge. To characterise perceptual processes and behavioural responses to behavioural determinants induced by the public ecosystem, a measurement model was developed based on the theories of D. Kahneman (Kahneman 2012) and R. Dunbar (Dunbar 2016).

THEORIES USED TO DEVELOP A MODEL TO MEASURE ANXIETY LEVELS

The results of decades of research by cognitive scientists on the workings of the human mind under cognitive load indicate a dual-process nature of cognitive processes, which D. Kahneman summarises as follows:

- System 1 works quickly and automatically, with little or no effort, the individual has no sense of conscious control over it.
- System 2 focuses the necessary attention on mentally demanding activities, such as complex calculations. System 2 activity is often accompanied by a subjective sense of focus, free choice and conscious action.

Moreover, the fast thinking system freely (without the participation of consciousness) translates experiences into impressions and emotions, which then become the primary source of conscious beliefs and purposeful choices of the slow thinking system, whose one of key tasks is to control our thoughts and behaviour (Kahneman 2012 p. 30–58). It should be noted here that complex cognitive processes do not take place in the mind considered as an independent part of the body, but they imply the involvement of the entire organism – muscles

tense up, blood pressure rises, heart rate accelerates, pupils dilate. Expenditure of mental energy means a literal loss of energy; System 2 thinking engages the nervous system much more strongly and it increases the demand for glucose more intensely than fast thinking, i.e. when reactions to stimuli are intuitive, reflexive (Sapolsky 2021). All this means that System 2 is engaged by humans relatively reluctantly – the dominant everyday principle is effort avoidance (cognitive ease).

From a cognitive point of view, the Covid-19 pandemic is a state of constant, dynamically changing threat. In such a situation, people mostly react reflexively, intuitively, in a maximally simplified way. Survival is what counts above all – a rapid, autonomic physiological mechanism is responsible for the basic stress response (Sapolsky 2010 p. 65–66). This is especially true in the initial phase of pandemic turbulence, when uncertainty is greatest and risks are difficult to assess – people then instinctively defend themselves by adopting a heuristic (simplified) mode of action (Paprocki 2020 p. 43). A relatively rapid reduction in effort levels is a natural necessity, otherwise a state of permanent mobilisation induces excessive levels of anxiety and leads to illness (Sapolsky 2010 p. 16–17).

Kahneman's dual-system model allows us to frame the Covid-19 pandemic as a field of pandemic anxiety induced by two communication ecosystems (public and private) involving two cognitive processes (automatic and reflexive). Creating awareness and entrenchment implied by the public ecosystem is the result of the synthesis of official messages of pervasive threat and alarming numerical indicators. Modelling of public behaviour is possible with the variables shown in Table 1.

Table 1: Determinants of behavioural modelling in the context of the Covid-19 pandemic

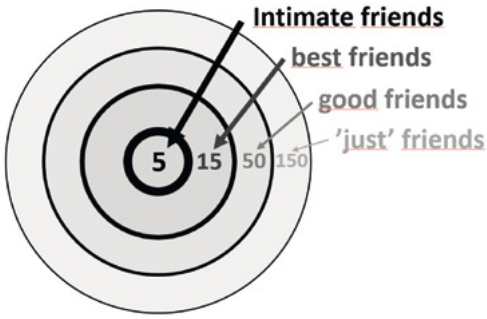
Cognitive processes	Field of impact	Ecosystem	Type of anxiety
System 1: automatic	physiology, praxis	private	empirical anxiety
System 2: reflective	statistics, directives	public	social anxiety

Source: own study

For the individual, satisfying the need for control on the basis of a private ecosystem means to monitor his or her immediate environment, to confront matters over which he or she has a perceived influence and to obtain support from the closest (Sapolsky 2010 p. 402–411). In the light of the research, R. Dunbar's social brain model complements the two-system model, as it describes the individual's

communication-behavioural pattern on a numerical scale of social relationships. The social brain principle is expressed in primates in terms of a cognitive limitation on the size of the social group centred around the individual. This limitation has an evolutionary basis and is derived from brain size and biological and socio-cultural complexity. The maximum number of social relationships that an individual can sustainably nurture has been estimated at 150. Individuals within this limit are regarded by the individual as well-known, relationships with them are based on a shared history, they involve trust, commitments and mutual support, and a willingness to help without much deliberation (Dunbar 2016 p. 73–95). The above model specifies the extent of the direct coupling of the human cognitive apparatus with the social structure, and thus makes it possible to define directly the extent of the influence of the private communication ecosystem. For the individual at the centre, a circle of 5 means 5 people with whom he or she interacts at least once a week, a circle of 15 (10 people) – at least once a month, a circle of 50 (35 people) – at least once every six months, a circle of 150 (100 people) – at least once a year. The total social time (the sum of the efforts devoted to nurturing social relationships, approximately 3.5 hours per day) is distributed between the circles as follows: circle 5 – 40%, circle 15 – 20%, the outer circles (50 and 150 combined) – the remaining 40%. The above figures describe the degree of emotional closeness, so they do not apply to, for example, interactions within the professional realm. Moreover, family members make up half of this 150-person set. The structure of intimacy and emotional closeness within the circles of stable interpersonal relationships surrounding the individual is shown in Figure 1.

Figure 1: Circles of stable relationships according to the R. model. Dunbar



Source: based on: R. Dunbar, *Human Evolution*; op. cit., p. 95.

Strictly speaking, the layer of acquaintances is the layer outside the 150 up to the next circle at 500. These are more casual, commonly one-way rather than reciprocal relationships.

We usually refer to the layers as support clique (intimate friends), sympathy group (best friends), affinity group (good friends) and active network ('just' friends).

The importance of social factors in the lives of individuals becomes particularly apparent in crisis situations, as indicated by a study carried out by J. Holt-Lunstad (Holt-Lunstad, Smith 2010). A meta-analysis of 148 epidemiological studies (involving a total of almost 309,000 patients; the only research criterion was whether the patient survived or died) showed that the most important factor increasing an individual's chance of survival in a crisis situation is the degree to which they are integrated into their personal social network and local community. In the research conducted for this article, it was therefore assumed that the crisis caused by the Covid-19 pandemic would direct an important part of people's cognitive resources towards monitoring and protecting their personal social capital, as they would seek all available ways to increase their chances of survival. Accordingly, it was assumed that information would be drawn from the private communication ecosystem, and that the baseline criterion for determining the level of threat would be the death of a close one (member of the 150-person set) caused by the Sars-CoV-2 virus. A case of death would constitute irrefutable evidence of the presence of a pandemic – empirical anxiety would be added to the social anxiety generated by reports emanating from the public communication ecosystem. And as the behaviours corresponding to the need for survival are mostly heuristic (instinctive, intuitive) in their nature, their course will be regulated by rapid thinking processes.

OPERATIONAL INDICATORS AND DEFINITIONS USED

Intensified by the Covid-19 pandemic, the need for survival reinforced the demand in individuals and social groups for data to assess epidemic risk. This data was essential because – especially at the beginning of the pandemic – it had a direct and immediate impact on people's behaviour. The persistent state of threat created anxiety on a population-wide scale. At the beginning of the pandemic, anxiety was mainly triggered by secondary data (statistics) and media messages. The ongoing study developed a definition of social anxiety, which is an attitude induced by the media system, stemming from systematically reported information on the death rate of Covid-19 sufferers. This attitude was environmentally experienced, reinforced by cognitive confusion induced by conflicting instructions how to ensure safety, by appeals calling for specific consumer behaviour, thus legitimised by socially relevant environments. The effect was behavioural modelling reinforced by moral panic.

As the situation developed, secondary data began to be supplemented by primary data, i.e. empirically (by individuals) observed cases of infection and death caused by the SARS-CoV-2 pathogen. Consequently, assessments of the threat to one's own survival were made on the basis of two sources of data: an external (official) one, represented by a system of statistical analysis, and an internal (individual) one, i.e. through personal experience (empirical data). The external source acted as the official communication ecosystem and its task was to translate scientific analysis into language accessible to the public and to formulate generally understandable conclusions and socially binding guidelines. The internal system, on the other hand, drew data from the immediate environment of individuals, and thus became more relevant with a time lag, i.e. when the secondary picture of the pandemic began to be successively supplemented by personally recorded events. Individuals' behaviour was thus shaped by two mutually divergent information ecosystems – in the first, data took the form of officially sanctioned logical-mathematical categories (statistics) and narrative categories (media messages), describing the pandemic on a macro scale filled with mostly anonymous cases. In the second ecosystem, the private information ecosystem, the picture of the pandemic was also made up of numbers and stories, but was parameterised by low figures, self-observations, personal values and accounts coming from people in the immediate environment. The study therefore took into account variables related to pandemic empirics, i.e. gender, the number of deaths recorded by respondents in each circle, the distance between the place of residence of the dead.

The picture of the phenomena outlined above provides the theoretical foundation for the exploratory research carried out, which, together with a dedicated measurement model, served to identify cognitive-behavioural and social determinants of behaviour. The implementation of the research project required the analysis of available secondary sources and the conduct of direct research. The information drawn for the indirect research was drawn from official reports published on the government websites of the Republic of Poland[2] .

To achieve the stated objectives, it was necessary to operationally define a set of necessary concepts. The indices described in Table 2 were used as the measures of mortality against Covid-19.

Table 2: Indicators used in the study.

Indicators	Description of the indicator
baseline mortality rate	officially indicated in the public ecosystem, for the determination of the initial cause of death due to COVID-19, from 18.04.2020, codes according to the WHO classification are used: "1. U07.1 COVID-19 – when SARS-CoV-2 virus is identified on the basis of a laboratory test (molecular RT-PCR), cases confirmed according to the definition of infectious disease cases for epidemiological surveillance 2. UO7.2 COVID-19 – when the virus is unidentified and COVID-19 has been diagnosed on the basis of clinical signs or epidemiological criteria, but the result of the laboratory test is inconclusive or unavailable";
baseline anxiety level	the product of the baseline index and the Dunbar's number
empirical mortality rate	The empirical mortality rate recorded by the respondents was calculated on the basis of the deaths observed by the respondents within the circles of friends and relatives (a given respondent reports the status of deaths within Dunbar's circles), where, based on the respondent's personal acquaintance with the deceased person, including knowledge of his or her general health and course of illness, the Sars-CoV-2 virus was indicated as the direct and sole cause of death.
empirical level of anxiety	the product of the empirical mortality rate and the Dunbar's number

Source: own study

The baseline mortality indicator in the model developed is the official Sars-CoV-2 virus mortality rate (used throughout the pandemic up to and including the present), defined according to WHO guidelines and presented to the public as the primary measure of pandemic risk**.**

Empirical anxiety was defined as an anxiety attitude resulting from personally recorded and observed deaths within individuals meeting the criteria for social proximity according to the R. Dunbar model. **Empirical anxiety** can be measured as the product of the empirical level of mortality and the Dunbar's number.

Social anxiety has been defined as an attitude induced by the media system, experienced environmentally, generated by systematically reported Covid-19 death rates, contradictory safety instructions, appeals calling for certain consumer behaviours, thus legitimised by socially relevant environments and inducing moral panic and cognitive confusion through inconsistent messages. An indicator of social anxiety is the level of baseline anxiety.

THE METHOD OF DATA COLLECTION

Exploratory research was conducted between March and June 2022 using a structured interview questionnaire. The questionnaire comprised an instruction operationalising R. Dunbar's circles of relationships, questions classifying

deaths and recording the distance from the respondent's place of residence and a classification metric. The subjects were students of the University of Bielsko-Biała (ATH) and Cavalry Captain Witold Pilecki State University of Małopolska in Oświęcim (MUP). The interviews were conducted by two independent research teams (the interview form can be found in the appendix). The primary research was accompanied by a series of questions subordinated to a central criterion: respondents' recording of covid deaths classified in the social set within their personal Dunbar number (Table 2). The Dunbar number represents, in the case of this research project, the benchmark necessary to capture the nature of the phenomena under study and is 150 people (Dunbar p. 33–56). This number could be considered higher if one accepts the findings indicating an above-average intensity of social interaction in young people (it is estimated that in 18-24 year olds this number could be as high as 250). It can also be lower if any of the alternative models described in the literature (where the minimum value is 100) were adopted. In the end, it was decided to stay with the value used by R. Dunbar (150).

Table 3: Basic data.

	ATH	MUP	Total
Number of respondents	1427	599	2026
Number of groups	111	40	151
Average group size	13	15	14
Number of groups with deaths	38	18	56
Number of respondents with deaths	73	22	95
Total number of deaths	64	37	101
Percentage of respondents reporting a death	5,68%	4,20%	4,64%
Average age for death	57,30	56,98	57,11

Source: own study

At both universities, the researchers visited 151 student groups and interviewed 2,026 students, representing approximately 30% of the total number of students at both universities. The minority of the groups (37%) included people who had lost a close relationship due to SARS-CoV-2 infection. A total of 95 respondents (4.64%) reported a covid death, several of them more than one (101 deaths were recorded overall). The mean age for a death case was 57 years, significantly lower than the official estimate for the Polish population (76 years)[3] .

Table 4: Data on age, relationship and spatial coverage.

	ATH	MUP	Total
Age groups for deaths (in years):			
between 30 and 39	3	6	9
between 40 and 49	14	2	16
between 50 and 59	15	10	25
between 60 and 69	14	12	26
between 70 and 80	9	5	14
over 80	3	2	5
no data available	6		6
Level of relationship (Dunbar circle) respondent-deceased:			
I (5)	3	4	7
II (10)	16	10	26
III (35)	31	12	43
IV (100)	8	11	19
no data available	6		6
Distance of permanent residence of respondent-deceased case:			
less than 1 km	7	3	10
1 to 3 km	7	4	11
4 to 10 km	16	7	23
from 11 to 30 km	11	13	24
from 31 to 50 km	7	6	13
over 50 km	5	4	9
no data available	11		11

Source: own study.

Among the deceased, there was not a single person under the age of 30, nor was there a single death registered among students. Half of the deaths were people aged 50–69 (50.5%). Most of the deceased (43%) came from Dunbar's circle 3 (friends of the respondents, meeting them at least twice a year). Most of the deceased lived within about 20 km of the respondents' permanent residence (45%).

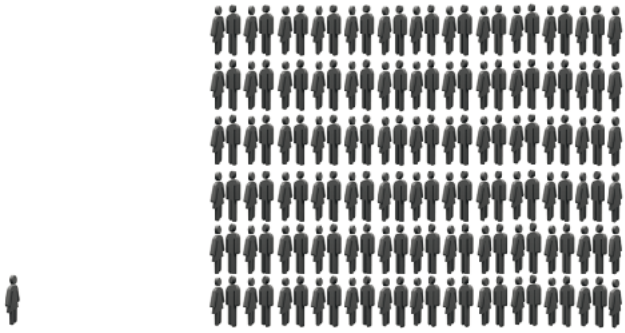
The time range for the study period slightly exceeded 2 years (registered from the date of the Covid-19 pandemic announcement to the end of the interviews). The criterion of covid death was verbalised by the researcher explicitly at the beginning of each interview and referred to the respondents' actual knowledge of the deceased. This approach was based on the assumption that each such death was a source of existential upheaval (also the real undermining of the support group) and intense inquiry (the matter of ultimate seriousness requiring thorough investigation) for the individuals comprising the community. After all, a death due to Covid-19 was no longer just a detail on a TV news strip – it imprinted a deep mark on the psyche becoming a permanent part of memory. In addition, the opinion of the respondent reporting a Covid death was verified in terms of the strength of judgement – only

those cases were recorded that were accompanied by a strong belief that, had the SARS-CoV-2 infection not occurred, the deceased person would certainly have lived on, as – to the best of the respondent's knowledge – his or her pre-sickness health was of no concern. The lack of medical expertise and the subjectivity of the respondents' attitudes was not a disadvantage in this case, as the aim of the survey was to determine the level of empirical/experiential anxiety, i.e. a spontaneous effect arising from natural categorisation (judgements and evaluations formulated in colloquial discourses acquire reality and permanence through fast thinking). Classification questions were used by the researcher to disambiguate the case in question both in terms of including/excluding the deceased person in/from the respondent's personal support group and establishing (after positive verification) his or her membership within a particular circle in Dunbar's model.

RESEARCH FINDINGS

In order to measure the main indicators, i.e. empirical mortality rate, baseline anxiety level and empirical anxiety level, it was necessary to develop a dedicated statistical model. For the purposes of this model, each respondent surveyed was assumed to be the centre of a socio-communication ecosystem with a weight of 150 (Dunbar's number), the individual voice is therefore a report of events occurring within the 150-person group.

Figure 2: Modelled range of the individual report



Source: own study

According to the above assumption, on the basis of the official statistics and the data collected during the exploratory study, it is possible to proceed to measuring the baseline level of anxiety, the empirical level of mortality and the empirical level of anxiety

The measurement of baseline anxiety was based on the official mortality rate for the SARS-CoV-2 virus, identified at 1.9% for a statistical unit. The mortality rate for the SARS-CoV-2 virus fluctuated over time – it was highest at the start of the pandemic and decreased as the pandemic progressed to reach 1.9% at the time of data compilation for this publication[4]. The baseline anxiety level represents the pandemic fear of losing someone from a 150-strong group of close ones. In other words, it is the fear of directly losing some amount of social support, which would result in a reduction in one's own chances of survival. It has been therefore considered that the level of anxiety would take on a percentage value, as it corresponds to the probability of death in the above group.

Accordingly, based on the official statistics and the data collected during the exploratory study, the baseline level of anxiety, the empirical level of mortality and the empirical level of anxiety can be measured (Table 5). Baseline anxiety was measured as follows. The measurement was based on the official mortality rate for the SARS-CoV-2 virus, identified at 1.9% for the statistical unit[5] . The baseline anxiety level represents the pandemic fear of losing someone from a group of 150 loved ones. In other words, it is the fear of directly losing some social support, which will result in a reduction in one's own chances of survival. It was therefore conventionally considered that the level of anxiety would take on a percentage value, as it corresponds to the probability of death in the above group.

We therefore calculate the baseline anxiety level as the product of the individual's probability of death and the Dunbar number.

$$baseline\ mortality\ level\ x\ Dunbar's\ number = baseline\ anxiety\ level \qquad (1)$$

The act of the measurement is executed by System 2, as it is the slow thinking path that supports mathematical symbolisations. In other words, this measurement allows us to identify sources of statistical reflection on the data derived from the public communication ecosystem. Thus, at a baseline mortality rate of 1.9% and a Dunbar's number of 150, we obtain the following probability number for mortality:

$$150\ x\ 0.019 = 2.85\ deaths$$

The baseline anxiety thus reached 285%, meaning a loss prospect of almost 3 persons (per statistical individual)[6]. Indeed, the above calculation is merely illustrative, as probability calculus is not a mirror image of thr actual social behaviour. Actual human reactions to a probabilistic threat are derived from much more complex determinants, the consideration of which would go beyond the scope of this publication[7] . And given the argument so far, the identified statistical response should be assumed to be the lowest strictly measurable level of anxiety determined

by the proposed model. Taking into account the intensity of information and its content, it can be concluded that a qualitatively new phenomenon is emerging in the Polish communication ecosystem – social anxiety established and reproduced according to the pattern used in everyday praxis, resulting from experiencing strong cognitive dissonance created during the construction of survival strategies in incompatible communication ecosystems.

Empirical indicators were measured using primary survey data (structured interviews). Measurement of empirical mortality rates required consideration of modelled sample range. The respondent represents 150 people in the study according to the number of friends in Dunbar's circles, and the study has encompassed 2026 respondents. On this basis, the size of the population feeding the private communication ecosystem was estimated. So, in order to estimate the empirical mortality rate, the deaths personally recorded by the respondents (101 cases) have to be placed within the modelled population (2026x150 = 303900 people). According to equation (2), the empirical mortality rate is:

$$empirical\ mortality\ rate = \frac{number\ of\ identified\ deaths}{size\ of\ the\ modelled\ population} \tag{2}$$

When substituted into equation (2), we obtain:

$$\frac{101}{303900} = 0{,}00033$$

This means that the empirical mortality rate is 0.033%. Similarly, according to equation (3) for the empirical level of anxiety:

$$empirical\ anxiety\ level = empirical\ mortality\ rate\ x\ Dunbar's\ number \tag{3}$$

When substituted into equation (3), we obtain:

$$150\ x\ 0.00033 = 0.05\ deaths$$

Thus, the empirical level of anxiety in the study is 5%, meaning a loss prospect of around 0,05 persons (per statistical individual). A summary of the results of the indicator measurements is presented in Table 5.

Table 5: Mortality and anxiety levels

Baseline mortality rate	**1,9%**
Baseline anxiety level	**285%**
Empirical mortality rate	**0,033%**
Empirical anxiety level	**5%**

Source: own study.

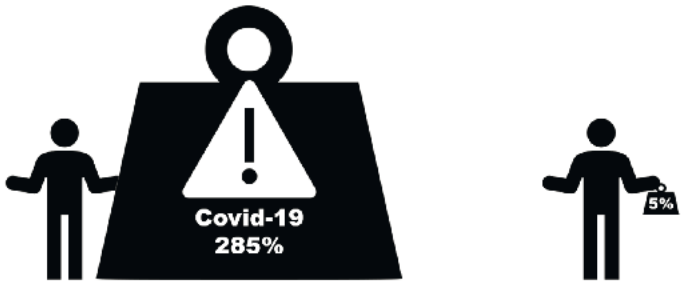
Particularly noteworthy is the functioning of the respondents' memory: it recalled 4 times more deaths originating from the three closest circles (76 cases) than from the last circle (19 cases; cf. Table 4). This is a result that dictates looking at memories of the Covid-19 pandemic as reports from structures of intimacy. On the one hand, the above result can be seen as a measure of the strength of the respondent's ties to the 50 closest people – in relation to the one hundred further acquaintances, the ratio of deaths is 1:8 (4 times more deaths in a 2 times smaller group). This vividly demonstrates the importance of locality – during the Covid-19 pandemic, the empirical distribution of concern collapsed around Dunbar's third circle edge. This distribution of anxiety about loved ones corresponds to the characteristics of Dunbar's model – the structure of memories recorded in the interviews largely coincides with the structure of the time budget spent to maintain stable social relationships. On the other hand, the almost one order of magnitude higher number of recalled deaths in the group of people, with whom the respondents were most strongly connected, may provide an insight into the mechanism of memory; significant deaths got remembered, the rest fell into oblivion[8] . The retrospective captured during the study demonstrates the strategic role of the first three circles of intimacy (50 people) during the Covid-19 pandemic. Another explanation for the above phenomenon could be that the Covid-19 pandemic caused the last circle of relationships to collapse. Both versions seem equally plausible and perhaps touch on deeper lying phenomena (especially in the light of the prevailing model of the social brain, which may have been significantly transformed during the pandemic period), and therefore require research verification in a separate research project.

CONCLUSIONS OF THE STUDY

The statistical juxtaposition of anxiety levels in the context of Dunbar's model illustrates the process by which the public communication ecosystem induces a state of social anxiety. In a crisis situation, the public media adopted a model of communicating through fear management, inducing and sustaining a state of anxiety and moral panic. The state of emergency fostered the implementation of

the garrison state model (Wroblewska-Jachna 2022). The image of the pandemic created in public communication channels indicated the pandemic threat with a strength 57 times greater than the value directly measured in the group of young respondents.

Figure 3: Comparison of anxiety levels: baseline/social anxiety (left) vs empirical anxiety (right).



Source: own study

Above all, the measurement method used demonstrates a significant inconsistency in the perception of the underlying pandemic threat, from which the following conclusion follows: the profound discrepancies between the recorded phenomena and especially between baseline and empirical levels of anxiety indicate extensive behavioural and communication dissonance during the Covid-19 pandemic, as well as amplification of decision-making noise (Kahneman, Sibony, Sunstein 2022). Individuals explored two data systems: the public, represented by statistical analyses (macro scale, secondary data), and the private, i.e. the personal experiences of specific individuals (micro scale, empirical data). The public source acted as the official communication ecosystem. Its task was to accessibly translate expert analysis into natural language and to formulate conclusions and socially binding guidelines in a generally understandable way. The private ecosystem, on the other hand, drew data from the immediate environment of individuals, which was the source of direct, eyewitness indications of the pandemic threat. It operated with a time lag in relation to the public ecosystem, but became increasingly important over time. With its help, individuals were able to confront official data with personal observations.

The ecosystems are therefore characterised by important differences. In the public ecosystem, the data took the form of a broad, highly dynamic stream of officially sanctioned logico-mathematical categories (daily updated statistics) and narrative structures (media content), depicting the pandemic on a macro scale, full

of indicators and phenomena with a high degree of abstraction and anonymity. The empirical ecosystem also built a picture composed of numbers and stories, but was characterised by a narrow range of exploration. The essence of this ecosystem is the everyday practice of life that people exercise within a relatively narrow circle of interdependence. It is thus the system through which small social worlds are reproduced – it sustains communicative routines and feeds the plot of colloquial narratives. Above all, however, the private ecosystem focuses the individual's attention on the immediate surrounding by answering the question of whether it is a safe, liveable environment. It should be noted that the ecosystems described, on the one hand, operated simultaneously and parallelly constructed the attitudes of individuals towards the pandemic. On the other hand, however, because of the fundamental differences between them, they should be considered separately.

A relevantresearch achievement was the determination of the extent of private social concern – during the Covid-19 pandemic this included the nearest 50 people. The measurements made during the project indicate the usefulness of the adopted research model, which proved to be a tool that enabled the systematisation of data on the basis of transparent criteria, providing insight into the structure of the basic determinants of behaviour during the Covid-19 pandemic. The results obtained make it possible to understand why people might not have been too concerned about COVID – it didn't have immediate effects on them, as only about 2% of the population experienced death 'close up' and 98% thought they were safe because they had no experience of death. The following might explain why so many people ignored the pandemic control strategies promoted in the public communication ecosystem, i.e. government instructions to get vaccinated, not to party or gather in large groups. Taking the above-mentioned micro-social budgeting patterns, as premises for the validity of the model used, it can be tentatively treated as a predictive tool for the phenomena induced by the private and public communication ecosystem. Finally, the results obtained during the study signalled the presence of phenomena that require further research.

DISCUSSION

The results of the conducted study illustrate the cognitive dissonance resulting from differences in the level of anxiety generated by the private and public communication ecosystem. In representative research conducted in May 2020 in Poland, an analysis of the subjective assessment of the level of anxiety conducted by carrying out surveys using an arbitrarily constructed scale of anxiety symptoms: depression, mental tension, fears about the future, insomnia, problems with concentration, depressing moods, breathing problems, pain in the chest, and digestive problems. The collected data enabled us to notice several regularities.

Fear of the pandemic was the strongest among educated women. Women and adolescents up to 24 years of age experienced depression more often than other respondents. A much lower level of fear of coronavirus was reported by people with the lowest socio-economic status, with limited access to the media, as well as by older people using traditional media (Sobierajski, Krzystanek 2023).

A review of international studies confirms that people who felt more anxious were those that followed the COVID-19 news most frequently. Much of the content appearing in the public ecosystem was speculative and thus perpetuated fear. In addition, anxiety levels were significantly higher in the respondents with at least one family member, relative or friend who underwent COVID-19 disease (Salari, Hosseinian-Far, Jalali, Vaisi-Raygani, Rasoulpoor, Mohammadi, Rasoulpoor, Khaledi-Paveh 2020).

The intensity of media use has been a key correlate in the level of anxiety and behavioral modeling in many countries, especially at the beginning of the pandemic. After a dozen or so months, the researchers observed that recipients became more sensitive to messages that could cause fear, despite the increasing number of deaths. Over time, messages lost their ability to increase fear in recipients (Stevens, Young, Taylor 2021).

The study that is the subject of the following article provides a theoretical explanation for the process of desensitizing recipients to the news. Cognitive dissonance caused by differences in inducing anxiety based on information from the private and public ecosystem caused a decrease in trust in the public information system and reduced the sense of risk. As it results from the observation of the behavior of young people at universities, over time they ignored the restrictions, e.g. they did not wear masks in public places. The conclusions of the research can be used to increase the effectiveness of public information strategies in the event of health crises.

NOTES

1 20200305-sitrep-45-covid-19.pdf (who.int) (accessed 20.01.2022).
2 https://dane.gov.pl/pl/dataset/2121, statystyki-zgonow-z-powodu-covid-19 (accessed 28.06.2022).
3 Percentage of age groups in total COVID-19 deaths - Chief Sanitary Inspectorate - Gov.co.uk Portal (www.gov.pl) (accessed 222.09.2022).
4 https://www.gov.pl/web/koronawirus/wykaz-zarazen-koronawirusem-sars-cov-2 (as at 15.06.2022)
5 The mortality rate of the SARS-CoV-2 virus was highest at the beginning of the pandemic and decreased as the pandemic progressed to reach 1.9% at the time of compiling the data for this publication, cf. https://www.gov.pl/web/koronawirus/wykaz-zarazen-koronawirusem-sars-cov-2 (as of 15.06.2022).
6 It should be noted at this point that the scale of fear assumed was not correlated with the number of officially identified infections, as it would then have to be assumed that at the

beginning of the pandemic, when the number of infections in the general population was proportionally low – the fear was negligible. The attitudes observed at the time indicated that the opposite was the case, as fear appeared at the outburst of the pandemic and grew exponentially in the initial period; (Paprocki 2020, p. 42).

7 Risk perception in the context of a pandemic threat can be described as follows: people are far more worried about the prospect of their possessions being depleted than the calculus of probability should dictate. In other words, the looming prospect of losing a loved one sows far more fear than reason dictates. Excessive anxiety is fraught with consequences, e.g. overvalued insurance policies and a tendency to make excessive concessions; cf. *Thinking, Fast and Slow...*, op. cit., pp. 411–421.

8 Human memory is not a device that generates a lossless copy of the sensations recorded in sensory channels. Memories are the product of a two-pronged, sequential selection process: the processing of the original data (real-time reactivity) runs separately, followed by the ordering/categorization of the data (retrospective filtering). Integration requires the assignment of ranks to experiences according to a criterion known as the peak and end effect (recollection = emotional intensity of a given experience + circumstances of its termination). In the case of memories of pandemic deaths, this can be put as follows – the strongest sensations (peaks) accompany the death of the most important people, which leaves behind deep mourning (the end); memories of loved ones remain vivid for a long time, deaths of less important people are forgotten; cf. *Thinking, Fast and Slow...*, op. cit., pp. 502–511.

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APPENDIX

INTERVIEW SHEET

Name and surname of the researcher, date of the interview: ....-.....-2022

Group ID	Number of respondents	Number of people affected by covid death	Age	Dunbar's Circle	Distance in km

Legend:

Group ID : designation of a group of students by name in the schedule of classes
Number of people in the group/respondents : the actual number of people in the lecture hall during the interview
Number of people affected by Covid death : number of students meeting the "empirical" criterion, i.e. their loved one died of Covid-19 (without comorbidities; a medical diagnosis is not necessary, the respondent's opinion/knowledge about the deceased is sufficient).
Age : age of the deceased person (can be indicative/approximate if not known exactly)
Dunbar's circle : a classification of a respondent's degree of intimacy with a deceased person
" **1** " (intimate friends, 5 people): family circle and closest friends with whom we meet, min. 1 time a week
" **2** " (best friends, 10 people): close ties, people with whom we actively nurture relationships , at least once a month
" **3** " (good friends, 35 people): good friends, people we contact several times a year , at least once every six months
" **4** " ("just friends", 100 people): distant friends, co-workers, people with whom contacts are not very close , at least once a year
Distance in km : the distance between the respondent and the place of residence of the deceased (the place of permanent residence of the respondent and the deceased counts).

Classification questions (we ask as many questions as necessary to ensure that we classify a Covid death according to the Dunbar model):

1. Whether the person belonged to a family (if so, we automatically include Dunbar's model)
2. When was the last time you contacted this person, how often? (the classification criterion is the maximum of the last 12 months before death)?
3. In the last 12 months preceding the death, did you call this person/sms/ messenger/whatsup? Have you sent her Christmas/birthday wishes/received such wishes?
4. Would you call this person in an emergency?
5. Do you still keep in touch with the deceased person's family?
6. Would you invite this person to a wedding, barbecue or party?
7. Have you been/wanted to attend a funeral?
8. Who was this person to you? [we save this answer for potential follow-up analysis]
9. Do you feel the lack of the deceased, the need for contact? Do you feel a loss? Do you remember this person? Would you like to see him/her?
10. Do you know this person by name?