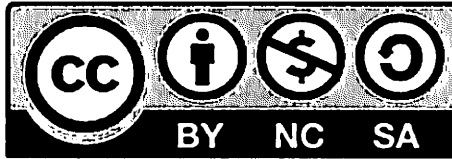


**USING FACEBOOK ANALYTICS TO MEASURE
AND MODEL THE SPIRAL OF SILENCE
IN A DEVELOPMENT DISCOURSE**

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This dissertation titled "USING FACEBOOK ANALYTICS TO MEASURE AND MODEL THE SPIRAL OF SILENCE IN A DEVELOPMENT DISCOURSE" is hereby accepted by the Faculty of Information and Communication Studies, U.P. Open University, in partial fulfillment of the requirements for the degree Doctor of Communication (DComm).

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BIOGRAPHICAL SKETCH

The author, more commonly known in his professional field as Leo Magno, was a journalist for more than two decades before joining the Asian Development Bank (ADB) as the Senior Editor and Senior Communications Officer of the Publishing Team of the Department of External Relations.

Leo is a former reporter, editor, columnist, and vice-president of different Philippine newspapers, both online and print. He has been assigned to reportorial coverage in 21 countries and has interviewed luminaries such as Bill Gates, Steve Jobs, and Alvin Toffler. He then established his own multimedia news outsourcing company which created social media, web, and broadcast content and strategies for the Discovery Channel, Yahoo!, TV5, Chevrolet, and Globe Telecom among others.

Leo created various syllabi and curricula on multimedia and social media journalism and taught those courses at two universities, for distance learning projects of UNESCO, and for ASEAN media students and practitioners under the media training programs of the Open Society Foundation.

Once a teacher, Leo the student now humbly submits this dissertation in his personal capacity and declares that:

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To you all, my sincerest gratitude. And thanks for the ride.

DEDICATION

Diego Magno and Cristy Magno are the two sources of sustainable and limitless energy that powered the creation of this work. Without them, this author would have run out of fuel and turned into a fossil as he barreled through an endless cycle of read-research-ponder-organize-analyze-calculate-write. Today I thank you both for your love, support, and patience through those four years. Today I finish four years of writing with these four sentences.

ABSTRACT

Previous studies have applied Elisabeth Noelle-Neumann's Spiral of Silence Theory to social media, yet no study has used social media metrics to quantify the minority-majority opinion gap and to construct a 3D model of an actual Spiral of Silence using field data from a development discussion. This research offers five contributions: (i) an equation that measures the gap in minority-majority opinion or positive-negative social media engagement rates, (ii) a ratio which is the output of the equation, (iii) an index which is the output of the ratio and which measures the size of the spiral, (iv) a theorem that demonstrates logical transitivity of numbers to denote the presence or absence of communication, and (v) a methodology to visualize and model the shape of the spiral in 3D. This study finds that an equation modified from Facebook's engagement rate formula—one that disaggregates positive from negative engagement (minority-majority opinion gaps) and allows data to be gathered even from respondents who do not have access to Facebook—can be used to quantify and then model in 3D an actual Spiral of Silence.

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Chapter One

BACKGROUND AND RATIONALE

This research investigates three communication-related subjects: (i) Elisabeth Noelle-Neumann's (1974) theory of the Spiral of Silence, (ii) social media analytics, and (iii) bottom-up development communication.

In the course of conducting the research, this study offers five contributions: (i) an equation that measures minority-majority opinion gaps using positive-negative social media engagement, (ii) a ratio which is the output of the equation, (iii) an index which is an output of the ratio and which quantifies the size of the Spiral of Silence, (iv) a theorem that demonstrates logical transitivity of numbers to denote the presence or absence of communication, and (v) a methodology to visualize and model the shape of the Spiral of Silence in three dimensions (3D).

At the heart of this study are proposed research and measurement tools that may help researchers gather and quantify opinion incongruence or minority-majority dissonance among research participants regardless of demographics.

Research data were fed into "the Equation" (capitalized in this study to distinguish it from the common noun) modified from Facebook's original equation to calculate engagement rates.

Facebook's engagement rate equation, in its current form, does not perform well in (i) disaggregating positive from negative engagement, (ii) accommodating offline analogs for Facebook "Reactions" and "Comments" to produce hybrid online-offline data, and (iii) disaggregating data by social demographic. Thus the need for the original equation to be modified for this research.

The output of this modified Equation is "the Ratio" (capitalized in this study to distinguish it from the common noun) which allows us to see if a gap between the minority opinion and that of the majority indicates the presence of opinion incongruence.

Use of the Equation and the resulting output, the Ratio, is being proposed to derive another numerical figure that quantifies the size and shape of the Spiral of Silence that occurs. This measurement of the spiral is called

“the Index” (capitalized in this study to distinguish it from the common noun).

To rationalize the absence or presence of communication as represented by numbers, a theorem was created specifically for this study. For this research, “the Theorem” (capitalized in this study to distinguish it from the common noun) was based on mathematical and logical transitivity axioms, a communication model, and a linguistic metaphor in an attempt to explain the transitivity of numerical representation of communication. The Index and the Ratio are numbers, and so the Theorem is utilized to show that—through logical transitivity—numerical figures can be used to indicate the presence or absence of communication.

Finally, a “Methodology” (capitalized in this study to distinguish it from the common noun) is offered by this study in an attempt to visualize, model, then construct the Spiral of Silence in 3D using the Equation, the Ratio, the Index, and the Theorem as data sources and foundations.

Why Quantify?

Why is there a need to quantify, visualize, and monitor opinion incongruence among groups of people? Organizations need to monitor constantly the opinion climate of their audience, the public they serve, or their collective internal and external stakeholders. Otherwise, they would not receive feedback on their performance regarding the adequate fulfillment of their mandate or duty.

Be they in public governance, the private sector, media, advertising, or marketing, organizations need to know if the people they serve and the people affected by their actions and policies—their stakeholders—are still engaged with the organization’s messages and actions. If not, the organization’s relevance would itself be in question.

Take for example organizations that deliver development aid. Is development assistance delivered to the people who need them? Are donors hearing the development needs of their beneficiaries or voices from the bottom up?

Without positive engagement with an organization’s messages or services, the audience—or in the case of development assistance, the beneficiaries—might fall into the Spiral of Silence and choose to withdraw from the conversation altogether. More so if the beneficiaries are not part

of the conversation since bottom-up communication is not encouraged. Thus, the organization would be rendered powerless to perform corrective and preventive actions to address the needs of its audience or stakeholders due to lack of engagement feedback.

Measuring Engagement

How does one measure engagement? How would engagement indicate whether or not stakeholders are falling into the Spiral of Silence?

The Spiral of Silence Theory posits that individuals publicly express their opinions when they perceive themselves to be part of the majority, yet fall silent when they sense they are of the minority (Noelle-Neumann, 1974). This communication phenomenon occurs when opinions become incongruent with the general opinion climate. That opinion climate influences the occurrence and even polarization of minority and majority views. The majority view could end up silencing the minority, yet that majority view could shift and could come from the organization itself, from the stakeholders, or from anyone within the group of discussants depending on how the conversation evolves.

Studies have tested and applied the Spiral of Silence Theory on social media, yet none have used social media engagement rates to quantify this spiraling effect and opinion incongruence in development communication dynamics. Moreover, there have been no attempts to extract engagement rate calculations from the online world to measure interaction among development project beneficiaries who are offline. Further—while there have been attempts to quantify the Spiral of Silence—there has been no study that visualizes the results then models it in 3D to show the actual shape of the spiral using engagement rates from actual field data.

This research extracts the engagement rate formula from Facebook's own internal online analytics then modifies it to produce what is referred to in this study as the Equation in an attempt to apply the formula to hybrid online-offline engagement analysis. The Equation uses Facebook as a data gathering medium to simulate real-world interaction. The analytics behind Facebook were converted into a concrete equation where engagement data can be inputted offline, as opposed to merely viewing automatically calculated data from Facebook's own automated analytics service called "Insights."

On Facebook, discussants are able to state opinions (“Commenting” or “Posting”), agree with other opinions (“Liking”), disagree with other opinions (“Reacting” negatively), or even propagate the opinion (“Sharing”) (Lee, 2015) similar to how it could occur in the offline real world. However, respondents without Facebook accounts or Internet connection need not fall into the Spiral of Silence by default—that is, being silenced simply because they cannot join the online discussion on social media. This is especially true with development project beneficiaries who are in less-developed areas and do not have access to Facebook or the knowledge to use social media applications.

A hybrid online-offline environment would enable respondents with Facebook access to use that social medium for engagement, while those without access can be surveyed on the field, physically shown images of the online discussion, then be allowed to participate by giving feedback to the discussion using offline surveying methods. While offline on the field, verbal and nonverbal cues could be used to tally their reactions and engagement with the topic of discussion. These verbal and nonverbal cues could serve as analogs of Facebook’s Reactions feature. Such a hybrid method would bridge the two worlds so that offline beneficiaries’ engagement rates could also be calculated, allowing engagement analysis to occur among both online and offline respondents. Such a calculation is made possible by taking Facebook’s original engagement rate formula, modifying it for hybrid online-offline data gathering, analyzing the data, and then calculating the engagement rates of the two data sets (online and offline) as if they were singular.

Quantifying, Visualizing, and Modeling the Spiral

This study fills the research void in quantifying then visualizing and constructing the Spiral of Silence in 3D using social media interaction and engagement about a development communication topic. That topic is whether or not agriculture deserves a bigger development budget than education. The virtual discussion forum used as a sample was an online-offline Facebook conversation among a group of project stakeholders.

In previous studies that tested the Spiral of Silence, a contentious topic for discussion was a common variable—topics such as nuclear energy, gay rights, climate change, and same-sex marriage, among others. Opinion-making was binary—respondents were faced with an either-or situation, whether they were for or against a certain issue. This is discussed further and more extensively in a later chapter (Review of

Related Literature). In this study, participants also faced a binary choice; they were asked which sector needed and deserved more development aid—agriculture or education. Interestingly and by design, half of the participants were farmers, while the other half were educators or students.

The development project that served as a small-scale pilot test of the Equation, the Ratio, the Index, the Theorem, and the Methodology was that of the University of the Philippines (U.P.) Manila's Indigenous Knowledge Systems and Practices (IKSP) program and its ancillary project called Lupungan. IKSP is a project at the Loob-Bunga Aeta resettlement area in Barangays Palis and Moraza in the Municipality of Botolan, Zambales, a province in the Central Luzon island of the Philippines. The study's participants were composed of the project proponents (10 professors and students from U.P. Manila's Department of Behavioral Sciences) and the project beneficiaries (10 Aeta community members represented by local officials and residents). Collectively they are called "stakeholder-respondents" in this study.

The objective was to see if participants' positive or negative engagement within the forum—both online and offline—would allow minority and majority views to surface in development communication dynamics among stakeholders regardless of social aggrupation, and to see if opinion incongruence and hegemony would occur among respondents regardless of demographics or socioeconomic classifications.

It must be stressed that the focus of this study is to invite researchers to test the conceptual Methodology as well as the Equation, the Ratio, the Index, and the Theorem on other projects larger in scale and scope. The IKSP program merely served as a platform on which this research could be pilot tested and operationalized on a small scale (which is why this study has both "Conceptual Methodology" and "Operational Methodology" chapters). Operationalizing the Methodology in more comprehensive studies is recommended to validate the Methodology itself, not necessarily to derive more conclusive results from the particular pilot test at hand.

Moreover, what is important in this study is not Facebook itself. This is not a study that seeks to replace traditional offline, on-ground surveys. This study seeks to use the modified analytics behind Facebook to calculate engagement rates (and consequently, the opinion incongruence gap). Since the Aeta beneficiaries did not have Facebook accounts, the page administrator account was used to input the engagement data for them. This entailed physically going on field to the project site and—while

offline—showing the beneficiaries the discussions on the Facebook Community Page created for this study. The Aeta community's responses and reactions were then recorded in the administrator account when Internet connection was available. Facebook itself thus served as an electronic survey form so that engagement data could be gathered, inputted, then calculated offline. Conversely, an all-virtual and all-Facebook group of respondents could also be used. The hybrid online-offline environment would only be used if some discussion participants do not have access to Facebook. In either scenario, engagement rate data can be recorded and the Equation can be used independently of Facebook after data has been tallied.

Development Aid and Hearing the Beneficiary Voice

This study chose the topic of development assistance and bottom-up communication because of different opinions that arise between or among project beneficiaries and project proponents.

The selection of beneficiaries for development projects has long been criticized for being top-down and non-participatory (Finsterbusch and Van Wicklin, 1987). Although on-ground consultations with beneficiaries are embedded in project cycles of development aid donors, such an exercise (i) exhausts resources; (ii) seldom employs bottom-up surveys; or (iii) seldom includes opinions from the public, making the beneficiary selection non-inclusive (Paul, 1987). The majority decision on which projects would be conducted and which loans would be approved come from the donors themselves (Oakley, 1991), augmented by inputs from government officials and development workers. It is important to hear from beneficiaries because they are also project stakeholders, and inclusive participation is key to successful development projects (Oakley, 1991).

This presents the possibility of silence spiraling in the development agenda. The potential silence comes from project beneficiaries as they could be overwhelmed by the majority view of the project proponents. However, the beneficiary group is not necessarily always in the minority. Depending on how engagement in the discussions occur and depending on the participants (such as the participation of "hardcore" or "avant-garde" nonconformists) (Noelle-Neumann, 1972), either the beneficiary or the proponent group could end up in the minority and the other in the majority. Alternatively, dissenting opinions could arise from anyone within the two groups; opinions within groups are not always unanimous.

This situation opens up minority-majority discussions on which direction a development aid project should take, regardless of the hegemonic groupings among the discussants. It also presents an opportunity to use Facebook's engagement rates to measure development communication dynamics and to see if the ratio of engagement about a certain topic is less than that of another. Doing so might also measure (i) opinion incongruence between, among, or within the two groups and (ii) the Spiral of Silence produced by that minority-majority disconnect.

To simulate real-world discussion, engagement via Facebook Reactions, Comments, and Shares were used to measure communication dynamics among the stakeholder-respondents to see if minority-majority voices would surface, regardless where the minority and majority voices emanate. This way, we can determine if the assumptions of the pre-Internet Spiral of Silence Theory are still applicable in the social media age, and we could attempt to quantify and visualize in 3D the opinion gap and the Spiral of Silence that manifests itself in the pilot study.

Note that this research takes after Nekmat and Gonzenbach (2013) who situated their study within climates of opinion in digital media. These are (i) the offline climate of opinion or the perceived opinion in the real world (since some of the respondents discussed among each other in real life), (ii) the online climate of opinion itself (the Internet at large), and (iii) a "within-forum" climate of opinion (the discussions inside the Facebook group) that reflects diverse views inherent within forum participants. Since all 20 respondents of this study engaged with each other within a closed Facebook group, they assessed the opinion climate primarily through the three factors above, whereas Noelle-Neumann lists media and the public at large as the major influencers of the opinion climate.

Noelle-Neumann (1974) also predicted "spirals within groups" (based on her "fear of negative sanctions" explanation) and "spirals between groups" (based on her "presentation of a public face" explanation). Evidence for these were supported by the study of Jeffres, et al. (1999) on the criminal trial of O.J. Simpson, which found that opinion incongruence can happen both within and between two clearly identified groups of respondents. These are—as classified by the researchers—the perceived minority (African-Americans) and the perceived majority (Caucasian Americans), making the climate of opinion "unambiguous" (Jeffres, et al., 1999).

This research also chose a clear identification of two groups (beneficiaries and proponents) which was included in the design of the IKSP project pilot test. Since this study looks at the subject matter through the minority lens,

it seeks to discover if minority-majority opinion dissonance would occur within or between (or both) the beneficiary and proponent groups, with the beneficiary group being the perceived marginalized minority. Such a design addresses one of the study's subquestions.

Adopting and modifying Facebook's engagement rate in development aid and project discussions, we may be able to see if respondents would behave as predicted in the Spiral of Silence Theory when a majority view is favored.

Summary of Research Gaps Addressed

This research fills the gap in existing literature in the sense that it:

- ▶ uses social media engagement rates processed through an Equation modified from Facebook's own;
- ▶ quantifies and disaggregates opinion incongruence between the minority and the majority in the form of a Ratio;
- ▶ uses a hybrid online-offline environment where respondents without Facebook access can still participate in the discussion;
- ▶ uses a Theorem to prove that numbers can represent the presence or absence of communication;
- ▶ uses the modified Facebook engagement rate Equation to measure the size of the Spiral of Silence in the form of an Index;
- ▶ provides a Methodology to quantify the size and shape of the resulting Spiral of Silence based on the dependent (output) variables so that the spiral could be visualized, modeled, then constructed in 3D;
- ▶ positions the minority-majority discussion in the context of development and the minority lens; and
- ▶ explores the possibility that the Spiral of Silence may fluctuate over time, resulting in an imperfectly shaped cone unlike that of Noelle-Neumann's original "perfect cone" model (it is also possible for engagement rates or opinions from both sides to negate each other, resulting in a stalemate and thus not creating a Spiral of Silence during the conversation; this is further explained in later chapters).

Chapter Two

DEFINITION OF TERMS AND CONSTRUCTS

What is Engagement?

Social media engagement and the Spiral of Silence are the two main constructs this research seeks to quantify.

Although the concept of engagement originated in broadcast audience measurement and marketing, the introduction of social media gave people the power to produce their own content without the need for expensive broadcasting or printing equipment, franchises, or licenses. This trend of audiences both consuming and producing their own content led engagement to evolve into measurement of how much the audience interacts or agrees with the content or the message that they themselves produce, such as those found in Facebook groups (Traphagen, 2012).

However, social media engagement is not a simple matter of how many Likes, “Fans,” or “Friends” one collects on Facebook. Marketers began to see engagement not only as audience approval but also as encounters between sender and receiver in a decentralized communications medium (Traphagen, 2012). Engagement has evolved into a measurement of how much communication participants interact with or are engaged in (Reactions, Comments, or Shares) (Junco, 2012) a certain discussion topic or—in marketing—brand engagement (Quintelier and Theocharis, 2012). To the extent that engagement is thought of as a metric, it measures how invested a person is, no matter for how short a time, in the content or message people are sending (Nasdaq and GlobeNewswire, 2013). Thus, engagement is also how much the audience interacts with content.

Engagement also translates to interest in, agreement with, or expression of support for a post or topic—all without necessarily being “vocal” about it (vocal meaning “voicing out” or writing in words an objection to or agreement with a certain topic). Engagement is an important measure because agreeing with a certain topic is not equivalent to being argumentative about it; one may choose to comment on the topic but others may show their agreement by Liking or Sharing the post, and is thus still an expression of support for that topic or post (Cvijikj and Michahelles, 2013).

More important in this discussion is that Facebook does not disaggregate positive and negative engagement, which is vital to the Equation to see if a minority-majority opinion incongruence exists.

What is the Spiral of Silence?

The Spiral of Silence, as defined by Noelle-Neumann (1974) herself, is “the increasing pressure people feel to conceal their views when they think they are in the minority.” The spiral is at its worst when discussants from a contradictory point of view have stopped participating altogether. Yet when there is no engagement gap or opinion incongruence in the first place, the Spiral of Silence would not occur.

This study seeks to quantify and visualize the size and shape of that silence in the context of development communication to see if a minority voice is being muted.

This study cannot, however, measure zero engagement because of the mathematical complications of dividing or multiplying by zero. It can only measure real numbers and not those that are undefined or indeterminate. Although the Index can quantify the spiral down to an extremely minute level as it approaches zero, the assumption in this study is that the process of communication already exists (with a value greater than zero) before it could be measured. In other words, the Equation cannot measure absolute silence or zero engagement from participants in a discussion.

What is Development Communication?

Development communication refers to the use of communication to facilitate social development (Quebral, 1972). It has for its primary purposes “social transformation and development,” and “the fulfillment of basic needs” (Flor, 2007). This study uses conversations from a development project at an Aeta resettlement area where Facebook was used both online and offline to foster discussions about development among the project stakeholders. Stakeholder-respondents were asked to choose between agriculture and education as the sector which they believe is deserving of more development aid budget.

What is Bottom-Up Communication?

Bottom-up communication is an inclusive form of interacting with participants in the communication process (Bang, 2003), taking into account the opinions and voices from actors who are traditionally marginalized, ignored, or “silenced.”

What are Stakeholders?

Stakeholders in a development project are people implementing, involved in, affected by, or benefiting from the project. These could be groups or individuals who have a stake in, or expectation of, the project's performance (Guide, 2001). These stakeholders include the funding bodies, the project team, development workers, contractors or consultants, government and nongovernment entities, or—at the other end of the spectrum—beneficiaries and people affected by the project (whether they are benefiting from the project or are marginalized, dislocated, or resettled by it) (Asian Development Bank, 2012).

For the pilot test, the term “stakeholders” includes project proponents (the U.P. Manila project team) and project beneficiaries (the Aeta residents and local government officials). Since all respondents are stakeholders of the project, they are also this study's stakeholder-respondents. This research seeks to discover if an incongruence in opinion would occur in the discussions, not necessarily between the two groups of respondents but also across and within both groups. What is important is the discussants' positive or negative engagement with the topic of discussion regardless of perceived classification, biases, or demographics.

What is Opinion Incongruence?

Opinion incongruence is the gap observed within the climate of opinion, or the gap between the dominant belief and the belief held by others (Huang, 2005). In social media, this translates to the gap between positive and negative engagement which may affect how people interact within the group and may in effect create minority and majority groups among the discussants.

The more people are engaged in or in favor of one opinion, the less they are with a contradictory opinion—and the incongruence manifests itself.

In this study, that engagement was measured using the Equation that formed the basis for quantifying opinion incongruity between the minority and the majority and for quantifying the Spiral of Silence that occurs.

Who are the Minority and Who are the Majority?

In this research, the word “minority” does not in any way refer to people differentiated from the social majority through circumstances such as ethnic or socioeconomic background. For the purpose of this study, the term refers to the minority opinion resulting from the hybrid online-offline discussion on Facebook.

The minority in a discussion is composed of stakeholder-respondents whose views are marginalized by a bigger number of engagement from discussants comprising an opposing view (the majority). Note that, in this study, being in the minority is not a factor of the number of members within a group as both project proponents and project beneficiaries have an equal number of members (10 each). It is a matter of which sector—agriculture or education—would get the bigger engagement measurement from the stakeholder-respondents.

Minorities are not necessarily defined by aggrupation or by demographics. Majority and minority views could surface from within the entire set of discussants composed of different demographics, and hegemony does not necessarily occur among the same demographic groupings as opinions may not be homogeneous per group. Dissent from within groups may also be observed.

For the purpose of this study, the minority or majority opinion could come from either the project beneficiary group or the project proponent group or from a combination of members from both groups, depending on the positive and negative engagement results of each respondent in the hybrid online-offline Facebook discussion.

In essence, agreement or disagreement (or engagement or non-engagement) with the discussion topic determines the minority and the majority opinions. It is not a function of the demographics of the stakeholder-respondents.

What is a Hybrid Online-Offline Environment?

A hybrid online-offline environment is one where respondents with access to social media (in this case, Facebook) are allowed to discuss and interact online, and then the discussion would be taken to the field to give offline participants without Facebook access a chance to respond. The offline reactions and feedback would later be inputted on Facebook when Internet access is available, and the online participants would in turn respond. These online responses would then be taken back to the field for reactions from the offline participants and so on and so forth.

Such an exercise simulates real-world interaction and engagement where physical distance and technology are no longer barriers to communication. It also mitigates the disadvantages of the digital divide where project beneficiaries in less-developed areas neither have the skills nor the equipment and Internet connection to use Facebook. Often, such a digital divide renders beneficiaries silenced by default—meaning they are not able to engage in discussion in the first place simply because of the above-mentioned circumstances.

What is the Equation?

The Equation is the first contribution of this study.

It is derived and modified from Facebook's equation for calculating post engagement rates. Facebook's original equation does not disaggregate several important variables—ones that are needed for this particular research to fulfill its objectives—and so the need for modification. The modified Equation thus has more utility by being a general research and measurement tool that can be applied to other studies that seek to measure opinion incongruence among discussants.

Facebook's equation to calculate engagement rate is expressed thus:

$$e = \left(\frac{l + c + s}{f} \right) 100$$

Image 1. Facebook Calculation for Engagement Rate



$$\text{Post Engagement Rate} = \frac{\text{\# of Likes + Comments + Shares on a given day}}{\text{Total \# of Fans on a given day}} \times 100$$

SOURCE: Socialbakers. (2016). *Formulas Revealed: The Facebook and Twitter Engagement Rate*. <https://goo.gl/7YkyRx> (accessed 25 November 2016).

Meanwhile, the Equation used in this research was derived and modified from Facebook's original equation and is expressed thus:

$$\begin{aligned} \text{Ratio} &= +E : -E \\ &\left\{ \left[\frac{\sum(+e)}{R} \right] 100 \right\} : \left\{ \left[\frac{\sum(-e)}{R} \right] 100 \right\} \\ &\left(\left\{ \frac{[(+x_1) + (+c_1) + s] + [(+x_n) + (+c_n) + s]}{f + s} \right\} 100 \right) : \left(\left\{ \frac{[(-x_1) + (-c_1) + s] + [(-x_n) + (-c_n) + s]}{f + s} \right\} 100 \right) \end{aligned}$$

The Equation calculates the positive (left side) and negative (right side) engagement rates that will be compared side-by-side with each other to show opinion incongruence and minority-majority opinion gaps.

What is the Ratio?

The Ratio is the second contribution of this study.

The Ratio is being proposed as a measurement tool to quantify the opinion incongruence or opinion gap between those who agree or disagree with a certain topic of discussion. This is done by quantifying then comparing the positive and negative engagement of the audience with that topic. A proportion in the form of a ratio is the result of such comparison, to see the disparity between two variables (the minority-majority views, or the positive-negative engagement rates).

Facebook's exact engagement rate formula was not used for this study. A modified version of the engagement rate formula was used since (i) Facebook calculates engagement as a whole without disaggregating positive and negative engagement, (ii) verbal and nonverbal analogs of Facebook's Reaction buttons were used for offline participants of this study, and (iii) Facebook calculates the average number of Fans on any given day whereas this study calculates the daily "Reach" or number Fans plus the number of Shares for the day.

This research calculates positive and negative engagement rates separately and has a specific number of Fans since it uses a Facebook Community Page whose invited members comprise the number of Fans themselves. Reach is substituted as a variable because it is the number of all people to whom the Facebook post was "served" or delivered. In this case, that number—the Reach—is the greater body of audiences to whom the message was sent, or the number of Fans (members of the group) plus the number of Shares on any given day.

What is the Index?

The Index is the third contribution of this study.

The Index is derived by first calculating the Ratio, then dividing the total positive engagement with the total negative engagement. The result is the Index expressed as one numerical figure. That number shows how big or small the opinion incongruence gap is between two points of view. As the number approaches zero, the more a certain opinion is being silenced and relegated to the minority. As the number grows bigger, the more that certain majority opinion is overwhelming the minority.

Indexes are often expressed in terms of a change from a base value. In the Ratio, the baseline is "1 : 1" (Ratio is "+E = -E" means both groups cancel each other; there is a stalemate; there is no opinion incongruence; there is no spiral). Thus, an Index of "1" (" +E divided by -E" or "1 divided by 1" equals 1) means no spiral is observed in the communication dynamics. The Index "1" is the base value (there is neither a minority nor a majority). An Index of more than "1" means that a particular set of opinions is in the majority, while an Index of less than "1" means that a particular set of opinions is in the minority, and that a spiral has occurred. The spiral gets more acute and tapered as the Index approaches zero, but zero is a value the Index can never reach. Because of the Theorem, the Index will never reach zero but it can exceed "1." The higher the

number is above “1,” the more overwhelming is the majority and the wider is the funnel at the top of the spiral.

What is the Theorem?

The transitivity Theorem is the fourth contribution of this study.

The Theorem created specifically for this study is used to rationalize the presence or absence of communications as represented by numerical figures, which is what the Index and the Ratio are—numbers. Theorems in general are statements proven based on existing axioms that are already considered to be true (Ben-Ari, 2012).

For this research, the axiom behind Reddy’s Conduit Metaphor of Communication (Reddy, 1979), the Axiom of Transitivity (Form, 1995), and formal logic and Boolean mathematics’ Transitive Implication or the Material Conditional (Marcus and Rips, 1979) were utilized and combined to create what this study calls, simply, the Theorem.

Transitivity axioms are widely used in various disciplines such as economics and mathematics, or even Transitivity Axioms in Game Theory (Harsanyi, 1992). The Theorem—used specifically for this particular research and developed from several axioms, a communication theory, and a linguistic metaphor—would apply to quantifying communication through social media engagement rates. The operating logic behind the Theorem is further detailed in later chapters.

What is the Methodology?

The Methodology is the fifth contribution of this study.

The Index value could be plotted as dots on the one-dimensional real line. However, if time is factored in, the Index values could be plotted across a two-dimensional plane to show us a line depicting the movement of the Index through time. If the Index values were plotted on three-dimensional Euclidean space, we would see the funnel in which the spiral would rotate from the point of origin. That process—in this study called simply as the Methodology—offers a way to visualize, model, then construct the Spiral of Silence in 3D.

Combined together, the Equation, the Ratio, the Index, and the Theorem can be used to create a Methodology that quantifies, visualizes, then constructs Noelle-Neumann's Spiral of Silence in 3D. This process is detailed in later chapters.

Chapter Three

RESEARCH PROBLEM AND QUESTIONS

Problem: The use of social media engagement equations to (i) measure minority-majority disconnect in development communication, (ii) measure and model opinion gaps, and (iii) construct Spirals of Silence has not been researched and warrants investigation.

Question: “What would be the size and shape of the Spiral of Silence when opinion gaps are measured and modeled using social media engagement rates?”

The four-decade-old Spiral of Silence Theory has been used extensively to explain minority-majority opinion and communication dynamics. However, a quantified relationship between opinions among discussants has not been measured to represent engagement gaps and the Spiral of Silence that could occur in conversations about development projects. This opinion incongruence is expressed herein as a Ratio and the quantified size of the spiral is expressed in the form of a numerical Index.

The research question has the following subquestions:

- ▶ How much total positive engagement was recorded?
- ▶ How much total negative engagement was recorded?
- ▶ How much positive engagement was recorded from project beneficiaries?
- ▶ How much negative engagement was recorded from project beneficiaries?
- ▶ How much positive engagement was recorded from project proponents?
- ▶ How much negative engagement was recorded from project proponents?
- ▶ Do the positive and negative engagement rates show a gap or incongruence in opinion?
- ▶ Is the gap or incongruence in opinion unanimously split between the two groups or does it occur among and within them?
- ▶ Can that gap be quantified as a ratio (the Ratio)?
- ▶ Does the gap indicate a spiraling process?
- ▶ Can that gap be expressed as a mathematical index (the Index)?
- ▶ Can that index quantify the size and shape of the spiral?
- ▶ Beyond the development sector, can the Equation, the Ratio, and the

Index be used together to measure other engagement dynamics such as demand-supply or receiver-sender communications?

Quantifying engagement in the development project discussion using the Equation is based on the assumption that if either positive or negative engagement rates are larger than the other, a majority and a minority are created. One group is silenced by the other group which overwhelms them. However, if positive and negative engagement rates are equal, they cancel each other out.

- ▶ $+E > -E$ means that negative engagement group is in the minority
- ▶ $+E < -E$ means that positive engagement group is in the minority
- ▶ $+E = -E$ means there is no minority or majority (therefore no Spiral of Silence)

Meanwhile, quantifying the spiral in the Spiral of Silence using the Index is based on the following:

- ▶ Index = 1, means there is no minority or majority. Engagement is equal.
- ▶ Index < 1, means there is a downward spiral in engagement for Opinion X and that this opinion is being relegated to the minority. The smaller the Index, the more pronounced and tapered is the spiral.
- ▶ Index > 1, means there is an upward spiral in engagement for Opinion X and that this opinion has overwhelmed the minority. The bigger the Index, the more overwhelming is the majority opinion and the wider is the mouth of the funnel.

Chapter Four

RESEARCH OBJECTIVES

This study's primary objective is to quantify, visualize, and construct a 3D model of a Spiral of Silence based on actual research data gathered from a small-scale pilot test. That data is based on positive-negative engagement rates gathered from a development discussion topic discussed on Facebook by 10 students and professors in Manila and 10 Aeta community members in Zambales.

The primary objective stems from this study's research question: "What would be the size and shape of the Spiral of Silence when opinion gaps are measured and modeled using social media engagement rates?"

To achieve the primary objective, the Equation, the Ratio, the Index, the Theorem, and the Methodology created specifically for this study are utilized. However, we first need to determine if the Equation, the Ratio, the Index, the Theorem, and the Methodology can be used as research tools to measure positive-negative engagement and minority-majority dynamics and to visualize the Spiral of Silence phenomenon that manifests itself from the small-scale pilot test.

This study proposes the use of the Equation to quantify engagement relationships between two groups of communicators and measure communication dynamics between the minority and the majority opinions that arise regardless of demographic groupings. The Equation, the Ratio, the Index, the Theorem, and this study's Methodology are thus both constructs and contributions of this study for the fulfillment of the research objectives.

As a communication measurement tool, the Equation may be able to:

- (i) quantify the opinion incongruence or engagement gap (positive and negative) between the minority and the majority opinion (using the Ratio),
- (ii) quantify the size and shape of the Spiral of Silence (using the Index),
- (iii) help researchers measure bottom-up communication,
- (iv) help organizations determine how well or how poorly they are listening to their audience or stakeholders,

(v) help researchers determine areas lacking in development assistance or other forms of service as identified by the stakeholder-respondents themselves,

(vi) help development aid donors and project proponents see if they are overperforming or underperforming from the viewpoint of the stakeholders, and

(vii) quantify relationships and dynamics between message receiver and sender in general (the Equation can be modified for other sectors in future studies).

The secondary objectives of this research are to:

(i) see if the Spiral of Silence Theory would apply in development communication dynamics using social media discussions,

(ii) thicken the discourse on the four-decade-old Spiral of Silence Theory in the context of social media, and

(iii) offer the metrics and methodology developed in this study as research and measurement tools for future studies.

Chapter Five RESEARCH VARIABLES

The independent (input) variables of this study—those of the Equation, in particular—are:

► the stakeholder-respondents' raw engagement data (Reactions, Comments, Shares, and Fans-plus-Shares [Reach]) denoted by the following Equation:

$$\left(\left\{ \frac{[(+x_1) + (+c_1) + s] + [(+x_n) + (+c_n) + s]}{f + s} \right\} 100 \right) : \left(\left\{ \frac{[(-x_1) + (-c_1) + s] + [(-x_n) + (-c_n) + s]}{f + s} \right\} 100 \right)$$

Where:

$+x_1$ = the first positive Reaction in the set of $+x$

$+x_n$ = the last positive Reaction in the set of $+x$ (summation index calculates first to last values)

$-x_1$ = the first negative Reaction in the set of $-x$

$-x_n$ = the last negative Reaction in the set of $-x$ (summation index calculates first to last values)

$+c_1$ = the first positive Comment in the set of $+c$

$+c_n$ = the last positive Comment in the set of $+c$ (summation index calculates first to last values)

$-c_1$ = the first negative Comment in the set of $-c$

$-c_n$ = the last negative Comment in the set of $-c$ (summation index calculates first to last values)

f = the number of Fans or members of the Facebook group on that day

s = the number of Shares of the original post (the question) on that day

The dependent (output) variables in this study are:

► the resulting Ratio (opinion incongruence gap) denoted by:

$$+E : -E$$

Where:

$+E$ = total positive engagement rates

$-E$ = total negative engagement rates

► and the resulting Index (to model the size and shape of the Spiral of Silence) denoted by:

$$\frac{+E}{-E}$$

Chapter Six

REVIEW OF RELATED LITERATURE

The creation of the Equation, the Ratio, and the Index was influenced in part by the works of Corrado Gini (1921); Withaar, et al. (2013); Effing, et al. (2011); Hall (2014); Asur and Huberman (2010); van Benthem (2003); Scholfield (1995); Kincaid (1979); and Flor (1984).

Gini's Coefficient (also known as the Gini Index or the Gini Ratio) is used to represent the income distribution of a nation's wealth, measuring inequality among certain values like income. A Gini Coefficient of 100% (or 1) shows maximum wealth distribution inequality, with only one person getting all the income while others have none.

Gini's ratio of inequality served as an inspiration for the Equation, the Ratio, and the Index in an attempt to determine—using Facebook data—the size and shape of the Spiral of Silence resulting in discussions about development aid in favor of agriculture and education and to see if a minority, if any, is being silenced.

Literature on Social Media Metrics

Meanwhile, Withaar, et al. proposed what they call a “social media indicator,” a matrix to measure the influence of social media content from individual users. Withaar, et al. build upon previous work on social media measurement done by Effing, et al. who gathered field results from the 2010 elections in the Netherlands and proposed future research to study how political parties could benefit from social media and reinvent the way they work with volunteers (Effing, et al., 2011). However, Withaar, et al. take a more general approach to creating a social media indicator in terms of participants' online influence. They argue that the influence of a single social media user heavily depends on the size of that user's social network (e.g., Fans or Friends) since, they say, social media is primarily about relationships between people.

For their social media indicator framework, Withaar, et al. did not rely on counting keywords or search terms, in contrast with Effing, et al.'s framework that is heavily keyword-based. Their research was based on data retrieved from a smaller group of individuals who are strictly

connected to the organization, and the objective was to measure the influence of someone in the community, not the entire mass.

This study is similar to Withaar, et al.'s methodology in that data is retrieved from a smaller group of individuals and not the entire mass. This "smaller group of individuals" is composed of the stakeholder-respondents of the Aeta development project pilot test in this research (both the project proponents and beneficiaries). And—like Withaar, et al.'s study—engagement data from this research is retrieved from respondents who are connected to the organization (all of them are connected to the IKSP Sambal Aeta project).

Meanwhile, Hall acknowledges the information dissemination and outreach potential of social media. Hall's study centers on a scientist or academic's social media profile versus the citation indexes of their scholarly work. To help quantify this, Hall proposes the creation of the "Kardashian Index," or "K-Index," a measure of "discrepancy between a scientist's social media profile and publication record based on the direct comparison of numbers of citations and Twitter followers."

Hall believes that media celebrity Kim Kardashian is famous simply for being already famous, and that the same phenomenon might apply within the scientific community—that scientists and academics are renowned simply because they are already renowned.

The K-Index is a calculation of the number of Twitter followers a scientist has, divided by the number of followers that scientist is expected to have based on his or her citation record. Hall plotted the number of scientists' and academics' Twitter followers against the number of scientific citations they have received to calculate their Kardashian index score. The study found that some scientists and academics had inflated numbers of Twitter followers versus the number of citations their works have received. A high K-Index may be interpreted as undue scientific fame while a low K-Index suggests that a scientist is being undervalued. According to Hall, a researcher, scientist, or academic whose K-Index is greater than "5" can be considered a "Science Kardashian."

There is also an online service called Klout which measures social media influence through the Klout Score. Klout uses more than 400 of what it calls "signals" from eight different social networks to update a person's Klout Score on a daily basis. The Klout Score is calculated through these signals derived from combinations of attributes, such as the ratio of reactions a person generates compared to the amount of content that person shares (Edwards, et al., 2013).

Klout explains that it derives data from the engagement social media users drive from unique individuals. One-hundred retweets from 100 different people contribute more to a person's Klout score than do 100 retweets from a single person (Klout, 2015). After measuring multiple pieces of data from several social networks, Klout applies them to the Klout Score algorithm, and then shows the resulting number on the person's Klout profile. The Klout Score is the accumulation of a person's influence across all of his or her social network memberships, not the average.

This study takes off from Hall's K-Index, the Klout Score, Effing, et al.'s keyword-based index, and Withaar, et al.'s social media indicator in the sense that social media is also being used as a real-world measurement of a phenomenon (in this case, minority-majority dynamics in development communication). However, instead of using Twitter in the K-Index and Klout, this research uses Facebook. Instead of measuring citations versus Twitter followers, this research makes use of engagement rates among project beneficiaries and proponents using Facebook posts, Reactions, Comments, Shares, and Fans.

Literature on the Spiral of Silence Applied to Social Media

Still fewer are research that study the applications of the Spiral of Silence to social media communications, and the results are similar.

For example, a study by Jang, et al. (2014) using controversial topics such as politics and gay rights showed that conflict avoidance and ambivalence about issues are negatively associated with Facebook discussions. The study also finds that users who have many Facebook friends are less likely to talk about politics and gay rights issues on Facebook. Jang, et al.'s study indicates that the Spiral of Silence applies even on Facebook.

The topic of Chen (2011) revolved around same-sex marriage, and although respondents were used to discussing the issue, they engaged more interpersonally to assess the climate of opinion from both close friends and broader circles of friends. Chen found that respondents spoke about the controversial issue in real life more than on Facebook or rather than being influenced by traditional media.

Miyata, et al. (2015) used behavioral log analysis based on Twitter responses and found a positive correlation between individuals' perception that their opinion represents the majority view and the number

of times they have posted on Twitter. The discussion topic was nuclear energy in Japan. They also found that similarity of opinions (majority) of a personal network on Twitter influenced their decision to speak out, but homogeneity of opinions does not influence speaking out by a minority group, validating the assumptions of the Spiral of Silence.

Another study that validates the theory's assumptions was conducted by Hampton, et al. (2014). The researchers conducted a survey of 1,801 American adults about a controversial public issue: former CIA employee Edward Snowden's 2013 revelations of widespread government surveillance of Americans' phone and e-mail records. They found that previous studies on the Spiral of Silence regarding people's willingness to speak up in various settings also apply to social media users. They found that those who use Facebook were more willing to share their views if they thought their "Followers" agreed with them. This, they said, was especially true if respondents did not feel that their Facebook friends or Twitter followers agreed with their viewpoint. For instance, the average Facebook user was half as likely as other people to say they would be willing to voice their opinion with friends at a restaurant. If they felt that their online Facebook "Friends" agreed with their opinion, their willingness to speak out in a face-to-face discussion with friends became higher.

The study by Gearhart and Zhang (2015), conducted using social networking websites also supported the Spiral of Silence Theory, concluding that subjects would speak out when encountering agreeable political content, but opinion expression is stifled when encountering disagreeable postings.

An earlier study by the same authors (Gearhart and Zhang, 2014) returned similar results when gay bullying was discussed using social media.

Similar results were received by Fox and Warber (2015) when they studied gay respondents also on social media. Participants whose gay identities were not known by the social network (i.e., those who were still in the "closet") showed a Spiral of Silence, wherein they were silenced by the perceived heteronormative majority. Meanwhile, participants whose identities were known (i.e., those who were "out") used the social networking site's features to empower their vocal minority to silence the dominant group.

Another Facebook-based study was conducted by Stoycheff (2016) who used a framework based on the Spiral of Silence Theory to determine whether or not the knowledge that one is being subjected to government surveillance and accepting such surveillance as necessary would affect

the relationship between one's perceived climate of opinion and willingness to voice opinions on Facebook. Stoycheff discovered that those who firmly believe that the government's monitoring programs are unacceptable "decide whether to share their views entirely independently of both perceived surveillance and the opinion climate." In other words, some respondents may have been members of the "avant-garde who are highly educated and vocal about their views" regardless of the discussion topic, survey conditions, and circumstances. The researchers also found that individuals who are very much against government surveillance may have been unwilling to ever share political beliefs online.

Meanwhile, Kwon, et al. (2015) found that exposure to diverse political opinions is positively associated with self-censorship online. However, while fear of isolation from offline contacts increases self-censorship, their study found a positive association with actual posting behavior and users tended to make more posts about the topic at hand.

The study of Porten-Che  and Eilders (2015), however—which used climate change as a discussion topic—received different results and conclusions. The researchers concluded that: "The findings show no support for the Spiral of Silence theory. Individuals who see themselves in the minority were even more likely to express their opinions."

In all these studies of the Spiral of Silence applied to social media, the common theme is that a contentious issue is being discussed. Whether it is about climate change, politics, gay rights, same-sex marriage, nuclear energy, or government surveillance, an issue needed to be discussed to see which views would become the minority, and which would become the majority. For this study, that issue is about budget allocation for development projects in the Philippines—whether it should be agriculture or education that should get bigger development funding.

Literature on the Opinion Climate

With regard to the climate of opinion that could affect discussant's willingness to speak up, research has shown that similar interactions exist in online discussions, even in social media. Nekmat and Gonzenbach (2013), for example, state that there are three—not one—climates of opinion within digital media. These are (i) the offline climate of opinion or the perceived opinion in the real world, (ii) the online climate of opinion itself, and (iii) a "within-forum" climate of opinion that reflects diverse views inherent within forum participants.

This study is similar to the approach of Nekmat and Gonzenback in that discussion participants are expressing their views to their reference groups, as opposed to society as a whole. The pilot test participants in this research, the beneficiaries and proponents of the development project (the stakeholder-respondents), is inside that “within-forum” climate of opinion, and so the assumptions of the Spiral of Silence Theory would apply to this smaller group of discussion participants instead of getting a sample from society as a whole.

Further, Hopkins (1999) makes the same observation, stating that these “within-forum” reference groups would likely be the group endorsing or “silencing” an individual’s opinion expression, as opposed to society as a whole. That forum could be a closed group of online participants, similar to a Facebook group this study used where members or Fans were by invitation.

Meyer and Speakman (2016) discovered the same effect in their study of news forums where, they say, “despite online advantages, the study finds the Spiral of Silence persists” even in closed groups.

Thus, such a “within-forum” climate of opinion would create similar effects for the participants instead of getting that opinion from the general public. Change in the opinion climate, according to Noelle-Neumann, may also trigger change in opinion expression.

For society as a whole, however, Noelle-Neumann argues that the biggest influencer of the climate of opinion—decades after the theory was introduced—is still the news media. This, however, applies only to the public at large and may not apply to closed online groups as explained earlier.

Literature on Social Media Metrics as Performance Indicators

Why use social media as a discussion and interaction forum to get the positive and negative engagement rates between the minority and the majority? Studies have shown that it is an effective platform for this purpose.

With proper research, one can build models to aggregate the opinions of the collective population and gain useful insights into their behavior, while predicting future trends (Leskovec, et al., 2006). Such a practice using social media could be useful in certain industries, and as concluded by

Huberman, et al. (2009) in their study using Twitter to analyze consumer behavior, gathering information on how people converse regarding particular products can be helpful when designing marketing and advertising campaigns.

The studies of Leskovec, et al. and Huberman, et al. have been helpful to this research because their objectives and methodologies are similar, namely (i) aggregating opinions using social media, (ii) disaggregating positive and negative engagement, (iii) gaining insights from such social media inputs, and (iv) predicting a trend or a behavior using the social media data collected.

Also relevant to this research is the paper by Asur and Huberman (2010) who created an equation that processes Twitter comments in an attempt to predict which movie would become a box office hit. They derived the Tweet rate by dividing the number of Tweets about a movie by the number of hours such a movie was being discussed, and factored in subjectivity by dividing positive and negative Tweets by the number of neutral Tweets.

For this study, the engagement rate was derived then positive engagement was divided by negative engagement to arrive at the Index, similar to the way Asur and Huberman created their own derivative calculations.

Asur and Huberman's conclusion is in accord with this study's relevance. They say that their research shows that social media feeds can be effective "indicators of real-world performance." In the case of this study, the "real-world performance" is whether discourse about a development topic would produce minority-majority engagement ratios. Real-world interaction and performance were also observed in this study through the offline engagement of the Aeta beneficiaries. The data gathered in turn allowed this study to quantify the resulting spiral based on the assumptions of the Spiral of Silence Theory.

Literature on Measuring Communication

This research also looked at studies that sought to measure communication theories, phenomena, and the process of communication itself.

On quantifying communication, van Benthem (2003) believes logic is not just about reasoning or truth, but also about communications between

people. Since what people talk about can be just as logical as mathematics, van Benthem states that communication phenomena can be measured by merging epistemic and dynamic logic and converting communications into mathematical representations.

Scholfield (1995) discusses this further and lengthily in his quest to gather data about communication and reducing this data into figures. Scholfield has created an extensive guide on quantifying language for the purpose of research and education by first observing the discussion, classifying it, then measuring it by assigning numbers to each classification.

For this study, the works of van Benthem and Scholfield became guides on how to classify positive and negative engagements from discussants and how to assign numbers to them. For the online responses, Facebook's variables were used (Reactions, Comments, Shares, and Fans). For the offline stakeholder-respondents, the work of Bousmalis (2009) has been influential on this study in the way nonverbal and verbal measurements were assigned as analogs of agreement and disagreement.

The works of Kincaid (1979) and Flor (1984) also influenced this study. Kincaid lists the biases associated with linear communication models, and his convergence model of communication implies that the primary purpose of the communication process is mutual understanding.

Kincaid explains that, in the convergence model the communication process always begins with "and then..." to remind researchers that something has occurred before the process can be observed. Participant A may or may not consider this before he or she shares information with participant B. Participant B then interprets the information Participant A created to express his or her own opinions about it, then Participant B may respond again by creating information to share with Participant A, and the process continues until one or both become satisfied that they have reached a mutual understanding.

This study also went through a similar process of back-and-forth asynchronous information sharing between the online and the offline respondents, although mutual understanding was not the end goal of the process—it was to measure positive and negative engagement and incongruence or dissonance in opinion, if any. Moreover, this study is in agreement with Kincaid's proposition that something must have happened first before the next stage of the process can be observed. As stated earlier, in this study the actual communication process must have started

first (with the presence of a sender, a message, and a receiver) before the communication dynamics could be quantified.

On the topic of mutual understanding, Flor posed the questions: “When (do) we say that communication has fulfilled this primary function?” “How do we know if ‘mutual understanding’ is arrived at?” “Is there a way to measure or to quantify the concept of ‘mutual understanding?’” Flor attempted to quantify Kincaid’s convergence through a Venn diagram plotted in a two-dimensional plane where the absolute value of the distance between the points was measured through the Pythagorean Theorem.

This study is similar to that of Flor’s in that the final measurement of the communication phenomenon was determined depending on whether the values were equal to, more than, or less than the other (for the Ratio). Instead of convergence, however, what this study measures is the relationship between positive and negative engagement. As to how numbers could be used to represent the presence of communication, this research produced its own rationalization through what is called the Theorem which—based on mathematical and logical axioms and communication theories—shows the process of transitivity in using numbers to represent communication.

Previous Literature as Foundations

Thus—based on research and literature previously conducted by scholars—earlier attempts have been made to quantify not just language and communication, whether in the real world or in social media, but communication theories as well (such as measuring Noelle-Neumann’s Spiral of Silence and Kincaid’s convergence model).

Moreover, based on previous research, attempts have been made to study the Spiral of Silence Theory’s applicability on social media.

This research proposes that, using Facebook, modified social media analytics can measure communications observed among discussants through their engagement and agreement/disagreement with a certain discussion topic (as opposed to just mutual understanding). This study positions the communication process as being bottom-up because (i) beneficiaries are communicating with project proponents about their development needs instead of the other way around and (ii) hitherto

marginalized communication participants (the offline Aetas) were given a chance to join the discussion.

The literature also show that social media is a rich way to get key indicators to test communication phenomena, such as minority-majority engagement and interaction.

However, while social media has already been used to test the applicability of the Spiral of Silence Theory, none of the studies focused on the use of social media engagement rates to include not only written or “posted” feedback, but also Reactions, Shares, and Comments as well. Neither did any of the literature use the Equation to get the engagement ratios of the majority and minority discussants, as the Equation was modified from Facebook’s original engagement rate specifically for this study. None of the literature disaggregated positive from negative feedback. None of the literature used a hybrid online-offline environment where even those without access to Facebook (the Aeta beneficiaries) could participate in the discussion, thus negating the disadvantages of the digital divide. Finally, none of the literature quantified and modeled in three dimensions the size and shape of the Spiral of Silence using social media engagement rate data.

And so, aside from attempting to quantify the gap between positive and negative minority-majority engagement, this research also attempts to measure and construct the Spiral of Silence produced in the discussions about development aid stemming from the Aeta community development project pilot test.

Chapter Seven

THEORETICAL FRAMEWORK

The Spiral of Silence

Noelle-Neumann's (1974) political science and mass communication theory of the Spiral of Silence Theory makes five assumptions.

Assumption 1 is the "threat of isolation." In the social collective, cohesion must be constantly ensured by a sufficient level of agreement on values and goals. To guarantee this agreement, society threatens with isolation individuals who violate the consensus.

Assumption 2 is the "fear of isolation." The formation of individual opinion and action is characterized by individuals' fear of becoming "social isolates."

Assumption 3 is the "quasi-statistical sense." As a result of fear of isolation, individuals constantly monitor their environment to check the distribution of opinions (the opinion climate) as well as the future trend of opinion. Such monitoring can involve tuning into various media.

Assumption 4 is the "willingness to speak out and tendency to remain silent." Individuals tend to publicly express their opinions and attitudes when they perceive their view to be dominant. In contrast, when people sense their view is in the minority, they become cautious and silent. This creates a gap or an incongruence in opinion.

Assumption 5 is that the interaction of these four factors leads to a process of formation, change, and reinforcement of public opinion. The tendency of one to speak up and the other to be silent starts a spiraling process which increasingly establishes one opinion as the prevailing one. Over time, changing perceptions of the opinion climate influence people's willingness to express minority opinions and establish one opinion as the predominant one.

Noelle-Neumann (1991) later on referred to these assumptions as hypotheses, the most significant one being that individuals publicly express their opinions when they are part of the majority, but when the public senses their view is in the minority, they fall silent (Assumption 4). What the public perceives as the climate of opinion will shape their willingness to speak out, and this in turn influences the perception of

others and their willingness to express their own views (Schulz and Roesser, 2012).

The theory was tested and improved upon by many other scholars in the pre-Internet era. Eventually it was tested many times using the Internet as a medium and using contentious discussion points to see if minority-majority views would emerge.

For example, Kim, et al. (2014) tested the Spiral of Silence on Internet communications and began discussing a controversial topic about genetically modified food to start a debate. Meanwhile, Liu and Fahmy (2011) validated the theory's assumptions when applied online, suggesting that when the likelihood of speaking out online increases, the likelihood of speaking out in the real world also increases, and vice versa. However, since the researchers tested several variables, different outcomes were also observed.

Schulz and Roesser (2012) deliberated different forms of Internet "conversations" in their study, with the conclusion that although their theoretical considerations indicate that the Spiral of Silence Theory is not suited for describing opinion formation processes in online communications, they maintain that the general logic of Noelle-Neumann's work is "not (yet) outdated." They do suggest that, due to the Internet, there could be a slowdown in the application of the theory compared to 4 decades ago, and that the Spiral of Silence might become a scarce phenomenon now that there are many sources of opinion, media of communication, and active participation in the global village and the marketplace of knowledge. Generally, however, from Schulz and Roesser's point of view there is no reason to assume that the theory is "invalid at large."

Quantifying Language and Communication

This study is quantitative in design and gathers data from a pilot test using observations (engagement frequency counts) and a single survey question (the question posed on Facebook). It seeks to measure language and communication dynamics and phenomena that occur as participants engage in discussion about development assistance preferred by stakeholder-respondents in the pilot test of the Aeta resettlement project in Botolan, Zambales. The end-result desired is quantification of engagement and interaction.

Scholfield (1995) has shown that in research and pedagogy, language can be represented by numerical substitutes to indicate thoughts that are in turn converted to communication. The use of language is first observed, converted to numbers, then classified.

According to Scholfield, there are three logical stages in quantifying then classifying language that would eventually lead to communication.

First, the nature of the variable a researcher wants to quantify should be specified. The communication variables being quantified in this study are the engagement of the participants (Reactions, Comments, Shares, and Fans). Second, the researcher must use or invent an explicit technique to gather the language that needs to be observed. In this study, the technique used is a hybrid online-offline method where data was tallied on a daily basis. Engagement was tallied online as they showed up on Facebook, while the Table of Cues of Agreement and Disagreement (Bousmalis, et al., 2009) was used for the offline component. Verbal and nonverbal cues (nodding, shaking of head, thumbs up, frown, laughter, etc.) was used to indicate agreement or disagreement with a certain discussion topic. The third and final step is to turn such observations (positive/negative engagement or agreement/disagreement) into numbers that would then be analyzed.

Why do we need to quantify communication in the first place? Scholfield states that in the pedagogical context, such quantification of language is used for screening students, classifying them, performing a prognosis or evaluation, and then certifying them. In the research context, Scholfield states that quantification is important for both qualitative and quantitative studies but in the end it is the research objective and question that would determine the variables to be quantified. Such quantification of communication phenomena then leads to more questions. Further research and improvements following the structured and processed quantified data could then lead to more knowledge.

Van Benthem (2003) builds on Scholfield's logical context of quantification of communications by stating that logic is not just about "single-agent notions" like reasoning or "zero-agent" notions like truth. He states that quantification is also about communication between people, and that numbers are the representation of such communication occurring between the discussants. What people tell and ask each other, according to van Benthem, can be just as logical as what we infer. He states that such interactive communications phenomena can be studied systematically by merging epistemic and dynamic or computer logic

(composed of “ones” and “zeroes” in binary language), leading to new types of questions and answers that are represented by numbers.

Hogan, et al. (2004) also sought to quantify communications by attempting to measure the “ripple” construct or the word-of-mouth effect of advertising. Word-of-mouth is viewed as an alternative to advertising, and Hogan, et al. attempted to quantify the way this communication phenomenon occurs and how it complements and extends the effects of advertising. The authors provide a simple approach to the measurement of post-purchase word-of-mouth sales effects through primary, secondary, and tertiary purchases by plotting those sales against succeeding purchases. The authors state that quantification of word-of-mouth communication or advertising can provide an important tool to assess the long-term effects of advertising campaigns.

Roberts and O'Reilly (1974) performed a similar test in organizational communication by assigning numerical figures to organizational variables such as trust, influence, mobility, interaction, accuracy, and satisfaction, among others. The end result was a taxonomy of organizational communication terms and metrics whose performance could be measured by numbers.

Finally there is the effort by Flor (1984) to quantify Kincaids' definition of “mutual understanding” in the Convergence Model of Communication (Kincaid, 1979). Flor makes an attempt at quantification by posing five propositions: (i) that communication is a process of convergence toward mutual understanding (based on Kincaid); (ii) that if the convergence of mutual understanding is visually represented through a Venn diagram, such would imply the existence of an epicenter within the two converging circles; (iii) that these epicenters may be plotted in a two-dimensional plane; (iv) that the union, or the moving toward each other, of these two epicenters in the course of time and the exchange of information constitutes the process of convergence; and (v) that in a two-dimensional plane, the absolute value of the distance between these points may be measured through the Pythagorean Theorem.

Quantifying Social Media Engagement

Meanwhile, quantification of social media communication and engagement has been studied extensively, mostly in the marketing and advertising disciplines.

Sashi (2012) explains that the marketing concept of social media use focuses on customer needs and starts with customers to determine the activities that a seller must perform in order to meet their needs. Customer engagement likewise focuses on customers and their needs in order to engage with them. While both the marketing concept and the customer engagement concept are customer-centric approaches, engagement is all about the customer's interaction with the organization's message or messages, Sashi says. Marketing professionals thus quantify such engagement to see the level of customer activity and interaction.

Hollebeek, et al. (2014) sought to quantify consumer brand engagement by producing a model for customer engagement. They state that the concept of engagement in social media is a significant construct that provides predictive and explanatory power of consumer behavior. Hollebeek, et al. also segregate engagement between customer and brand engagement and identify differences between individual and community interactions to a certain message.

Similar to the study by Hollebeek, et al., Knight (2014) measures the value of social media engagement by first identifying variables such as the objects of analysis (Likes, Comments, Shares, bibliographical links, etc.) and the means of measurement (number of engagement actions, hits, position on search engine, etc.). In the end, engagement became synonymous with audience interaction with the content of the social medium and how the audience likes or dislikes (agrees or disagrees with) the content.

For this study, that agreement/disagreement or like/dislike dichotomy is called the positive/negative engagement with the development discussion topic at hand (whether or not agriculture deserves a bigger development budget than education).

And so language and communication are quantified for further research, and so too does such quantification happen in social media communication for various purposes (marketing, advertising, organizational communications, etc.). Engagement is the social media equivalent of interaction with a message, and such interaction or engagement can be positive or negative. One could infer that when there is engagement, there is interaction. And if that interaction is measured by assigning numbers through variables (such as Reactions, Comments, or Shares), there is a communication process occurring as represented by numerical figures that indicate agreement or disagreement. That

rationalization for representing the presence of communication using numbers is performed in this study through the Theorem.

Through the Theorem, the Ratio, and the Index, the resulting engagement numbers could then represent the presence of communications that could in turn indicate a minority-majority opinion incongruence gap or a Spiral of Silence.

Engagement Rate and Audience Reach

The concept of engagement originated in broadcast audience measurement and marketing, but the introduction of social media and “prosumers” or consumers who also produce their own content (Toffler, 1990) led engagement to evolve into measurement of how much the audience interacts or agrees with the content or the message, such as those found in Facebook groups (Traphagen, 2012).

Yet engagement in the domain of social media is not a simple matter of how many Likes or Fans one collects on Facebook. Marketers see engagement exactly for what it is—as engagements—or as actual encounters between the sender of the message or content and the receiver in a decentralized communications medium (Traphagen, 2012).

Engagement measures how much discussants interact with or are engaged in a certain discussion topic (Junco, 2012). In marketing, it could be engagement with a brand (Quintelier and Theocharis, 2012). Engagement measures how invested a person is in the content or message (Nasdaq and GlobeNewswire, 2013).

Thus, engagement is also how much the audience interacts with content. Engagement is also an agreement with or expression of support for that post or topic. It is an important measure because agreeing with a certain topic does not necessarily require one to be argumentative. Others may comment on the topic, while others may express their agreement by liking or sharing the post (Cvijikj and Michahelles, 2013).

On Facebook, what are the variables being counted to measure what is collectively called “engagement”? A study by Carr (2016) lists Shares as having the biggest percentage (85%) of what 130 corporate respondents consider as the most important measurement of engagement, followed by engagement time (82%), comments (76%), page views (51%), visitors or Fans (47%), offline impact (28%), and others (6%).

Facebook's "Insights" feature has created a new set of data analytics now widely used by marketers seeking to measure the connection or engagement of their brand, message, or content with the audience (Lee, 2015). However, Facebook's engagement rate calculation does not factor in negative engagement, especially with the introduction of the Reactions feature in February 2016 where users can not only Like a post (thumbs-up, laughing, heart, or surprised icons) but can also express disagreement or disapproval of a post (sad or mad icons).

The disaggregation of positive and negative engagement is vital to the Equation to see if a minority-majority opinion incongruence exists. What Facebook calls "Unlike" is not necessarily a negative reaction—it is merely the act of reversing the original action of "Liking" a post. Thus, not "Liking" it is not equivalent to a negative engagement—it merely shows inaction or ambivalence on the part of the audience.

Moreover, Facebook's current post engagement rate calculation only counts the number of Fans of a given Facebook page—not Reach—making the base equation inaccurate (Allard, 2012). It does not count the number of times that content was Shared to other people on Facebook. Instead what should be counted is Reach or the number of Fans plus the number of times that content was Shared. Reach is thus the total number of audience to whom the content was delivered—not just the number of the Facebook page's Fans—because those Fans may decide to Share that content to their network of friends who are not necessarily fans of the Facebook page. The exponential audience growth given by Shares gives content greater reach (Traphagen, 2012), a significant difference from traditional television audience measurement due to the social and "sharing" nature of social media networks, where the television analog is "word-of-mouth."

In addition, Carr's 2016 study shows that "offline impact" measured 28% in the importance rating of engagement variables in her study. To measure not just online engagement but also those that were observed offline, this study assigns directly observed physical, nonverbal, and verbal cues as analogs of online Facebook actions such as Liking, Commenting, or Reacting to a post. Those cues of agreement or disagreement with a topic were then used as quantifiable measurements that correspond with Facebook's online metrics.

Contributing Theories

Aside from Noelle-Neumann's Spiral of Silence Theory, this study's use of social media to gather feedback from development project stakeholders is influenced by four other theories. This research looks into the Social Exchange Theory (Emerson, 1976), Social Penetration Theory (Altman and Taylor, 1973), Social Network Analysis Theory (Wasserman and Faust, 1994), and the Social Media Integration Theory (Bailey, 2011).

Emerson's Social Exchange Theory (1976) is rooted in economics but views arguments from the sociological and sociopsychological perspectives to posit that human relationships are formed using subjective communications and cost-benefit analysis exchanges. This theory became helpful in this research in the engagement aspect between the project beneficiaries and proponents. They weighed their options and formed their opinions on which sector—agriculture or education—should get the bigger development budget.

Altman and Taylor's Social Penetration Theory (1973) proposes that as relationships develop, communication becomes deeper. This theory became useful in this study as the call to interact and discuss escalated on the Facebook page, possibly creating affinity among stakeholder-respondents with common interests and opinions, whether they are project beneficiaries or proponents.

Wasserman and Faust's Social Network Analysis Theory (1994) is cybernetic in nature, and is described as the process of investigating social structures by using network and graph theories. Individual actors are "nodes" within the network, and the ties that connect them form the network (much like how social media connect people or "nodes"). This theory became useful in this research in establishing the use of the engagement rate as a measurement tool, counting the number of "nodes" in the form of people (audiences or Reach or Fans) reached by Reactions, Comments, and Shares.

Meanwhile, Bailey's Social Media Integration Theory (2011) finds that 67% are more likely to perform a certain action on a subject they follow on Twitter and 51% are more likely to do the same thing by followers on Facebook. This, according to the authors, is due to the exposure, feedback, and engagement they encounter on social media. Such engagement and feedback became evident in this study by Day 2 of the field research, when both online and offline stakeholder-respondents started voicing out their opinions.

These four theories contributed to the social media portion of this study. The first two (Social Exchange Theory and Social Penetration Theory) embody the sociopsychological aspect of this study, while the last two (Social Network Analysis Theory and Social Media Integration Theory) are related to the cybernetic and quantitative component of this study.

Katz, et al.'s (1973) Uses and Gratifications Theory also contributed to this study in the context of Facebook being used in marketing. Marketers began exploring the use of social media and attempted to discover why people use such social networks. The theory was useful because it was audience-centered, and marketers wanted to know what people do with media as opposed to what media do to people (Ruggiero, 2000).

Yet even before the Uses and Gratifications Theory, audience measurement systems were already developed by Elder and Woodruff (1939) who later sold the patent for their "Recorder" invention to Arthur Nielsen, giving rise to Nielsen Media Research which embarked on measuring audience size, composition, and reach on radio and television. Decades later, Facebook developed its own metrics to determine audience size by the number of Fans. This in turn gave rise to measurements of engagement and Reach, which are variables of this study.

And so the constructs of "engagement" and "reach" come from media marketing concepts from the first half of the 1900s, tracing its roots to the advent of radio and television. Social media in general became studied through the Uses and Gratifications Theory (Katz, et al., 1973) for marketers to determine what people do on social media and for companies to better engage with their audience.

From the viewpoint of hearing the minority "voice," this research is rooted on the assumptions of the Spiral of Silence Theory (Noelle-Neumann, 1974). Noelle-Neumann's theory discusses, among others, "isolation" (not only fear of physical separation but also doubting one's capacity for good judgment) which is an important part of all processes of public opinion. The farther one is from the majority in terms of viewpoint, the more likely the person would abstain from contributing to the shaping of public opinion and, in effect, the less likely that person's opinion would be heard or contribute to social change. This theory forms the cornerstone of this study's bottom-up direction of viewing the research problem using the minority discourse lens, that the decision to deliver development aid usually does not take into consideration the views of the minority.

There have been many studies exploring the applicability of the Spiral of Silence Theory in online media, but few focus on its application in social media. Those few social media-centered applications of the theory show mixed results. Some conclude the theory applies even to social media, some conclude that they apply only under certain conditions, while one study concludes that the theory does not apply at all to social media.

Based on the theories cited, what more could this research add to the existing body of knowledge? Epistemological assumptions and quantitative research are correlated since researchers seek to gather quantifiable proof to support their findings. Any research contains within it “assumptions about what constitutes knowledge” and that these epistemological assumptions are “foundational in the development of criteria for assessing the value or worth of data generated by research” (Beatty, 2009). What would then constitute knowledge (epistemological assumptions) for this research, with the assumption that reality is singular and with the process of defining what counts as knowledge as far as quantitative research is concerned?

Using quantitative thinking within a scientific framework to analyze data gathered from the stakeholder-respondents' Facebook Community Page, the base numbers (the positive engagement or $+E$ and the negative engagement or $-E$) would be gathered. Such quantitative research is a methodical process of investigating a particular topic or communication phenomenon that involves measurements of quantifiable data which can be interpreted using a mathematical approach (Anderson, 2009). And this is precisely what this study is about—after calculating for the engagement rates and the Ratio, the resulting Index would then be used to measure the size and model the shape of the Spiral of Silence in 3D.

And so this study differs from others because of the use of the Equation, the Ratio, the Index, the Theorem, and the Methodology to model and construct the Spiral of Silence. The basis for quantification of the variables in this study is the engagement rate which was not used in previous studies.

The discourse of representation (Mumby, 1997) is used in this research because communication is framed as a means of further studying already established relationships, such as the relationship among the stakeholder-respondents (beneficiaries and proponents and their minority-majority engagement relationship). The study observed if results from that smaller group (online and offline members of the Facebook

Community Page, the IKSP small-scale pilot test) could represent a greater body of the population.

The discourse of representation also equates “knowledge” and “truth” with “the scientific method.” It is also focused on (i) the division between the subject (the researcher) and the object (knowledge) and (ii) the development of research tools to ensure this separation is strictly observed objectively (Mumby, 1997). In this study, Facebook’s engagement rate equation, the Equation, the Ratio, and the Index serve as the research and measurement tools.

In the seven traditions of communication theory (Craig, 1999), the Facebook engagement rate and the Equation in this study can be situated in both the cybernetic and the sociopsychological traditions. In calculating the engagement rates and the minority-majority ratio between and within project beneficiaries and proponents, communication was theorized as information processing (using Facebook as a medium to post their messages; the information gathered from the stakeholder-respondents were processed; the data were analyzed to make sense of the numbers; the numbers were fed into the Equation; then the size of the spiral was expressed as an Index), and problems of communication were theorized as noise, overload, or underload (duplicate entries were filtered and Facebook Reactions, Comments, Shares, and engagement rates were counted).

The study is also sociopsychological in nature, where communication is theorized as interaction among individuals including expression, interaction, and influence and where the problem of communication is theorized as the study of behavior to achieve specific outcomes (choosing whether agriculture or education deserves a bigger budget).

This study employed the minority discourse lens. The $+E$ and $-E$ are essentially a collection of feedback from the stakeholder-respondents gathered via social media, processed through a mathematical Equation, and converted into a Ratio and an Index. Project beneficiaries’ views and demands for development aid are not often heard. As explained earlier, selection of development aid is usually top-down, relegating the beneficiary voice to the minority group.

In summary, this is a quantitative pilot test using observations (engagement frequency counts) and a survey (the question posed on Facebook) using epistemological assumptions based on Mumby’s discourse of representation. It is both under Craigs’ sociopsychological (Social Exchange and Social Penetration theories) and cybernetic (Social

Network Analysis and Social Media Integration theories) traditions, using the minority discourse lens (Spiral of Silence Theory).

Chapter Eight

CONCEPTUAL METHODOLOGY AND FRAMEWORK

This study's conceptual methodology and framework are guided by the research question, which is: "What would be the size and shape of the Spiral of Silence when opinion gaps are measured and modeled using social media engagement rates?"

The following steps are needed to answer the question and achieve this study's objective:

- (i) Create a hybrid online-offline social media environment where a development aid question would be posed and answered by discussion participants.
- (ii) Using the Equation, log and quantify the results of the discussion to see if opinion incongruence would occur (gap in minority-majority opinion or positive-negative engagement).
- (iii) Using the Ratio, determine the final engagement rate and the Index.
- (iv) Using the Index results, tabulate the numbers needed to visualize the size of the spiral.
- (v) Proceed only if the results pass the provisions of the Theorem.
- (vi) Model and construct the resulting Spiral of Silence in three-dimensional Euclidean space to see its shape.

Step 1: Create a Hybrid Social Media Environment

The social media environment selected for this study is Facebook. A Community Page is ideal, one wherein the administrator selects the invitees so as not to clutter the page with unwelcome members, discussions, and reactions. The Facebook page should not be a closed group, as members of the group will not be able to Share their posts, and "Sharing" is one of the ways an opinion is propagated on Facebook.

Moreover, this research is a hybrid online-offline study, whereas Facebook's engagement calculation occurs purely online. Offline impact cannot be dismissed as a variable since it accounts for 28% in the

importance rating of all engagement variables (Carr, 2016). To measure not just online engagement but also those that were observed offline, this study assigns directly observed physical, nonverbal, and verbal cues as analogs of online Facebook actions such as Liking, Commenting, or Reacting to a post.

As offline analogs of Facebook's Reactions, this study used the Table of Cues of Agreement and Disagreement (Bousmalis, et al., 2009) to recognize nonverbal and audiovisual cues of agreement or disagreement. The table counts gestures, facial expressions, verbal cues, body posture, and audiovisual vocal cues as signals of agreement or disagreement with a topic.

Step 2: Log and Quantify the Results Using the Equation

This study utilizes a social media metric in an attempt to quantify communication dynamics between the minority voice and the majority voice, regardless of demographic affiliation. That social media metric was based on the one used by Facebook.

The Spiral of Silence Theory (Noelle-Neumann, 1974) disaggregates two groups of discussants: those holding the minority view and those holding the majority view. That is why positive and negative engagement with a discussion topic is also disaggregated in the Equation. The minority and majority views will make themselves manifest once the positive and negative engagement rates are derived. The result is the Ratio which measures the proportion of positive engagement compared with negative engagement. Positive engagement is then divided by negative engagement to create a whole number, called the Index. Both the Ratio and the Index are numerical figures derived from mathematically calculating engagement through the Equation developed for this study.

In marketing, customer engagement is a significant statistic that shows interaction with the organization's message or messages (Sashi, 2012). Engagement is seen as the concept of interaction in social media and as a significant construct that provides predictive and explanatory power of consumer behavior (Hollebeek, et al., 2014). One can measure the value of social media engagement by first identifying variables and objects of analysis such as Likes, Comments, Shares, Fans, and others (Knight, 2014).

That is why Facebook wants to show its users how their Facebook content is engaging the audience—to prove that theirs is an effective social medium.

However, Facebook's engagement rate equation does not disaggregate positive from negative engagement, and the number of Fans alone does not measure the exponential dissemination of the content to other audiences in the Facebook network (friends of friends). In the advertising industry, this is referred to as the "ripple" or the "word-of-mouth" factor (Hogan, et al., 2004). Whereas this study seeks to measure the Spiral of Silence in communications, Hogan, et al. sought to quantify communications by attempting to measure the "ripple" construct or the word-of-mouth effect of advertising.

In social media, however, the total number of Shares plus Fans is a more significant metric because of the exponential dissemination of the Shared content to friends of Fans and to friends of friends and so on and so forth, giving the content greater reach (Traphagen, 2012). This is a significant difference from traditional television audience measurement due to the social and "sharing" nature of social media networks, where the television and advertising analog is word-of-mouth.

This is Facebook's original engagement rate equation, borne of marketing needs to determine what the audience does on social media and to find out how companies can better engage audiences with their messages:

$$e = \left(\frac{l + c + s}{f} \right) 100$$

Where:

e = post's engagement rate, according to Facebook's calculation (not for this study)

l = number of Likes (note that there is no "Dislike," or negative engagement variable)

c = number of Comments

s = the number of Shares of the original post

f = number of Fans per day (but for this study, "f" is substituted with "R" or Reach, the number of members [Fans] of the group plus the number of Shares of the post per day)

Facebook calculates engagement by adding the number of Likes, Comments, and Shares and dividing the sum by the number of Fans. The quotient is then multiplied by 100 to derive the values in percent (the engagement rate is a percentage). It is important to note that the calculation for the Facebook engagement rate above is the one used by Facebook itself. However this study's values for e , l , and f have been modified because (i) whereas Facebook only captures data for Likes, this study captured data for both "likes" and "dislikes" or positive and negative feedback through Reactions, represented by x ; (ii) since positive or negative Reactions instead of Likes were used, the value e also changed; (iii) we are using a Facebook group with invited members (but not in a closed or exclusive group), affecting the original equation's f variable—the average number of Fans on any given day that the Facebook page is operational; and (iv) instead of counting Fans we are counting Reach, or the number of Fans plus the number of Shares of the original post (or the total number of people who were reached by the post), represented by R . Thus we cannot just take Facebook's engagement rate equation then merely plug that into the Ratio Equation. Another and more significant modification in this study is the disaggregation of positive and negative engagement ($+E$ or $-E$) which the original Facebook formula does not have.

That is how Facebook's original engagement rate equation evolved in this study to the modified Equation below. It disaggregates positive and negative engagement and accounts for daily total Reach instead of just Fans—born from Elder and Woodruff's (1939) original concept of audience "reach" from the dawn of radio and television—and the Uses and Gratifications Theory (Katz, et al., 1973) which seeks to determine what people do with media as opposed to what media do to people.

$$+E : -E$$

$$\left\{ \left[\frac{\sum(+e)}{R} \right] 100 \right\} : \left\{ \left[\frac{\sum(-e)}{R} \right] 100 \right\}$$

$$\left(\left\{ \frac{[(+x_1) + (+c_1) + s] + [(+x_n) + (+c_n) + s]}{f + s} \right\} 100 \right) : \left(\left\{ \frac{[(-x_1) + (-c_1) + s] + [(-x_n) + (-c_n) + s]}{f + s} \right\} 100 \right)$$

These are the positive (left side) and negative (right side) engagement rates that will be compared side-by-side with each other, where:

$+E$ = total positive engagement rates

$-E$ = total negative engagement rates

$\Sigma(+e)$ = summation of positive engagement of all respondents

$\Sigma(-e)$ = summation of negative engagement of all respondents

R = Reach of post on that day, or total number of people to whom the post was delivered, which is the number of members in the Facebook group (f) plus the number of people to whom post was Shared (s)

f = the number of Fans or members of the Facebook group on that day

s = the number of Shares of the original post (the question) on that day

$+x_1$ = the first positive Reaction in the set of x

$+x_n$ = the last positive Reaction in the set of x (summation index calculates first to last values)

$-x_1$ = the first negative Reaction in the set of x

$-x_n$ = the last negative Reaction in the set of x (summation index calculates first to last values)

$+c_1$ = the first positive Comment in the set of c

$+c_n$ = the last positive Comment in the set of c (summation index calculates first to last values)

$-c_1$ = the first negative Comment in the set of c

$-c_n$ = the last negative Comment in the set of c (summation index calculates first to last values)

For positive (left side) calculations, the dividend for $+E$ can be derived thus (simply substitute positive with negative values to calculate for $-E$):

$$\Sigma(+e) = \sum_{i=+e_1}^n +e_i$$

Where:

$\Sigma(+e)$ = summation of positive engagement of all respondents

$+e$ = a positive engagement post

$+e_1$ = the first positive post engagement value in the set of $+e$

n = the last positive value in the set of $+e$, same number as the set's population (summation index calculates first to last values)

$+e_i$ = indicates that summation index calculates first to last $+e$ values

Step 3: Determine the Final Engagement Ratio and the Index

Euclid and Joyce (1996) define a ratio as a comparison of objects of two quantities that shows us the relationship between those two quantities. It is also defined as the relationship between two numbers indicating how many times the first number contains the second. For this study, the ratio being derived is the relationship between positive (left side) and negative (right side) engagement rates of the online-offline Facebook discussions among stakeholder-respondents of the Aeta resettlement area in Botolan, Zambales. We are looking for how big or small is the opinion incongruence or gap between those who agree and disagree with the discussion topic (i.e., whether agriculture or education should get the bigger development aid budget).

The resulting Ratio (opinion incongruence gap) is denoted by:

$$+E : -E$$

Where:

$+E$ = total positive engagement rates

$-E$ = total negative engagement rates

Since that Ratio shows us how much of the left-side value (positive engagement) contains the right-side value (negative engagement), we could also extrapolate a figure of how large or small one value is (in comparison with the other). That would now be the resulting Index, which is derived thus:

$$\frac{+E}{-E}$$

Ratios can be converted into fractions and fractions can be converted into a single numeral that shows how big or small the number is in relation to the base number "1." If those two numbers are the positive and the negative engagement rates, the resulting single numeral would be the quantified gap between positive-negative or minority-majority opinion.

That gap is the opinion incongruence gap, a mathematical representation of how much some of the sample population think in contradiction with the others. That number is an index that shows how close or far a certain opinion is straying from the dominant opinion. That Index of “straying away” and moving toward “0” is the Index of people falling into the spiral.

Indexes are often expressed in terms of a change from a base value. In the Ratio, the baseline is “1 : 1” (Ratio is “ $+E = -E$ ” means both groups cancel each other; there is no opinion incongruence; there is no spiral). Thus, an Index of “1” means no spiral is observed in the communication dynamics. The Index “1” is the base value (there is neither a minority nor a majority). An Index of more than or less than “1” shows a Spiral of Silence occurring in the discussions. An Index of more than “1” means that that particular set of respondents and their opinions are in the majority, while an Index of less than “1” means that that particular set of respondents and their opinions are in the minority. The spiral gets more acute and tapered as the Index approaches zero, but zero is a value the Index can never reach. The Index will never reach zero but it can exceed “1.” The higher the number is above “1,” the more overwhelming is the majority.

Step 4: Tabulate Numbers Needed to Visualize the Spiral’s Size

Allport (1937) stresses the importance of the process of shaping public opinion and “viewing the phenomenon as a process with a time dimension.” Scheufle and Moy (2000) state that the perceived climate of opinion and its development over time are critical factors in the Spiral of Silence. It shows us which opinion, over time, is likely to become dominant or extinguished. This is in accordance with this study’s recommendations that such an exercise of quantifying engagement could become a tool for corrective and preventive methods in communication dynamics.

Other authors like Neuwirth (1995) believe that “once a spiral is set in motion, all persons favoring the minority viewpoint eventually should fall silent.” However, such is not included in Noelle-Neumann’s theoretical assumptions. Noelle-Neumann (1979, 1992) herself emphasizes the time factor, resulting in a spiraling process which establishes one opinion over time as the predominant opinion, and that opinions can shift over time as a dominant one slowly emerges.

In other words, the spiral may not manifest itself literally overnight—it may take some time. Moreover, the spiral is not unstoppable once set in

motion, contrary to Neuwirth. That is why this research has a time factor on the y-axis.

And so, for this step, it would be best if the Indexes were tabulated against a time factor to observe if opinion shifts occur as the discussions progress. Moreover, the time factor automatically gives the tabulated results a second dimension on the y-axis, the Indexes being on the x-axis.

Step 5: Proceed if Results Pass the Provisions of the Theorem

This study uses numbers to represent language and communication, and is consistent with van Benthem (2003) who believes that what we tell and ask each other can be just as logical as mathematics and that communications phenomena can be measured by merging epistemic and dynamic (computer) logic—where information is converted into binary numbers—ultimately converting communications into mathematical representations. This study is also consistent with Scholfield (1995) who gathered communication data and reduced this data into figures. Scholfield has created an extensive guide on quantifying language for the purpose of research and education by first observing the discussion, classifying it, then measuring it by assigning numbers to each classification. All variables in this study (the respondents, the Reactions, the Comments, the Shares, the engagement rates, and the resulting Ratio and Index) are represented by numbers.

To rationalize number representation of the presence or existence of communication, this research introduces its own transitivity Theorem. The Index and the Ratio are numbers, and so the Theorem is utilized to show that—through logical and mathematical transitivity—numbers can be used to indicate the presence or absence of communication.

The Theorem is based on Shannon and Weaver's communication model (Shannon and Weaver, 1949), Reddy's Conduit Metaphor of Communication (Reddy, 1979), the Axiom of Transitivity (Form, 1995), and formal logic and Boolean mathematics' Transitive Implication or the Material Conditional (Marcus and Rips, 1979). The Theorem stipulates that the Index resulting from the Ratio which in turn results from the Equation can never reach the value "zero."

The Zero Conundrum. Why is it not possible for the Index to reach zero? The Index is obtained by dividing positive engagement by the negative engagement. This presupposes that both positive and negative

engagement rates have a value greater than zero, for what communication process is there to observe in the first place if there is zero engagement or interaction? Moreover, division by zero presents a totally new set of paradoxes altogether.

One problem with quantifying communication (or anything, for that matter) is when a variable returns the value "0" (zero).

In both Facebook's original equation and the modified one developed for this study, there are division and multiplication operations for either side of the Ratio (summation of engagement divided by Reach, then multiplied by 100 to derive the values in percent). This means that, if either dividend or divisor (either the engagement summation or the Reach) returns a zero value, it would result in either an indeterminate or undefined figure (Kaplan, 1999). Then that indeterminate or undefined number would still need to be multiplied by 100 to get the total engagement rate for both sides of the Equation to get the Ratio, leading us back to yet another indeterminate or undefined value (Seife, 2000). This is because of the Commutative Axiom of Multiplication. An undefined or indeterminate number multiplied by 100 is the same as multiplying 100 with an undefined or indeterminate number, and will always return an undefined or indeterminate value. While 100 is a value and a definite quantity, something undefined does not have quantity since "undefined" is a quality (Gries and Schneider, 1995).

And then the Ratio will need to be converted into a fraction and another division operation to convert that fraction into a numerical Index, once again leading us to either an indeterminate or undefined value.

While the Index can return an extremely low number that approaches zero, it is dependent on the resulting Ratio. And since the Ratio is derived from the positive and negative engagement rates, those two cannot have the value "0." And since the total engagement rates are derived from Reactions, Comments, and Shares divided by the number of Fans plus Shares, those too cannot have the total value "0."

The Theorem. This study's Theorem—a statement that has been proven on the basis of previously established and generally accepted axioms—was derived from the axioms mentioned in this section.

Earlier, this dissertation discussed the need to quantify communication to monitor its performance and possibly do corrective measures when and where needed or warranted. However, the zero conundrum not only applies to mathematics but to communication as well.

Take, for example, the grandfather of all communication theories, Shannon and Weaver's (1949) *Mathematical Theory of Communication*. Shannon and Weaver broadly defined communication as "all of the procedures by which one mind may affect another." Their communication model consisted of an information source (sender), the source's message, a transmitter, a channel, and finally a destination (receiver). In this study, Facebook acts as the transmitter and channel—leaving us with sender, message, and receiver.

Eventually, Shannon and Weaver's standard communication model included the encoder and the decoder, who encode or decode a message by translating an idea into a code in terms of bits. A code is a set of symbols or signs used to transmit a thought through one or more channels to elicit a response from a receiver. Later, Shannon and Weaver also included the noise factor into the model.

In summary, there needs to be a source (sender), message, transmitter, channel, and destination (receiver) for the communication process to exist. With no source or sender, a message will not exist, regardless of the existence of a transmitter, a channel, and a receiver. No noise will be recorded over the channel of communication since there is no message. And without a message, the receiver will not receive anything and there will be no feedback either. Without a destination (receiver), the message would not be delivered anywhere. However, take one sender with one message transmitted over a channel delivered to a receiver and the communication process begins.

The same is true on Facebook. With no source to send a message or no Facebook account holder (sender); no post, Comment, or Reaction (message); no Internet (transmitter); no channel (the Facebook page); and no Fans (receiver)—there will be no communication.

As Kincaid (1979) explains in the convergence model, the communication process always begins with "and then..." to remind researchers that something has occurred before the process can be observed. In this study, engagement must have first occurred before it could be observed and then represented as numbers.

Such is also reflected in Reddy's (1979) *Conduit Metaphor of Communication*. In this metaphor, the speaker puts ideas (objects) into words (containers) and sends them (along a conduit) to a hearer who takes the idea/objects out of the word/containers. The metaphor's assumptions are that (i) language functions like a conduit, transferring thoughts bodily from one person to another; (ii) in writing and speaking,

people insert their thoughts or feelings into the words; (iii) words accomplish the transfer by containing the thoughts or feelings and conveying them to others; and (iv) in listening or reading, people extract the thoughts and feelings once again from the words.

Meanwhile, the Axiom of Transitivity and Equivalence Relations (Form, 1995) states that if $a = b$ and $b = c$, then $a = c$. If the value "1" is equal to the presence of one sender, one message, and one receiver; and a combined set of sender-message-receiver indicates the presence of communication; then by Reddy's Conduit Metaphor of Communication, the Axiom of Transitivity and Equivalence Relations, and Boolean mathematics' Transitive Implication or the Material Conditional (Marcus and Rips, 1979); the number "1" would represent the existence of a communication component (verbal or nonverbal, as observed in this study of the Aetas and following Reddy's Conduit Metaphor).

The assignment of numerical figures would thus show us the existence of communication components, and engagement is one such component. If so, perhaps the assignment of numbers can also represent the existence of engagement, the ratio of such engagement on both sides, and the size and shape of a communication spiral. If zero returns an undefined or indeterminate number, then communication cannot be quantified, meaning engagement has to start with a number above zero. That is also why the spiral, as measured in this study, may reach an infinitesimally small number in terms of proportion between the positive and negative engagement but will never reach a point of zero engagement. This is consistent with the idea that having zero source (sender), zero message, zero transmitter, zero channel, and zero destination (receiver) will result in zero communication. As far as this study is concerned and designed, the additional elements of communication in Shannon and Weaver's model are analogous to Facebook—a sender encodes a message into Facebook which also acts (along with the Internet) as the transmitter, signal, and decoder.

Thus we are left with the base requirements of sender, message, and receiver—with Facebook taking care of the rest in the background—so that we could now perform transitive implications or inferences to denote the presence of communication.

In formal logic and in Boolean mathematics, the Transitive Implication or the Material Conditional is an axiom or postulate, a statement that is taken to be true to serve as a premise or starting point for further reasoning and arguments (Ben-Ari, 2012).

The following expression is a property of implication based on the Transitive Implication or the Material Conditional and is always true for any logical values of variables (Marcus and Rips, 1979), where the symbol " $\Rightarrow$ " means "implies" or "if-then."

$$(a \Rightarrow b) \Rightarrow [(b \Rightarrow c) \Rightarrow (a \Rightarrow c)] \text{ or } (a \Rightarrow b) \text{ and } (b \Rightarrow c) \text{ then } (a \Rightarrow c)$$

Under the assumptions that:

a = final engagement rate is greater than zero

b = sender, message, and receiver are present

c = communication is present

And since $(a \Rightarrow b)$ (if " a ," then " b "; or " a " implies " b "), if final engagement rate is greater than zero, then that number above zero indicates the presence of sender, message, and receiver.

And since $(b \Rightarrow c)$ (if " b ," then " c "; or " b " implies " c "), if sender, message, and receiver are present, then communication is present.

And since $(a \Rightarrow c)$, then that numerical figure above zero indicates that communication is present.

Suppose that the transmitter and channel in Shannon and Weaver's Mathematical Model of Communication is Facebook that can be taken as a given since this is the only medium of communication used in this study to enable two-way discussions by first encoding the message, transmitting it via the Internet, then decoding it—all using Facebook. Suppose that any dividend variable x (Reaction), c (Comment), or s (Share) greater than zero represents the presence of a message and a sender (message could only have been sent by a Facebook page member or inputted by the page administrator on behalf of a respondent, so one message equals one sender). Suppose that any divisor variable f (Fans) or s (Share) represents the presence of a receiver (one Fan or one Share means it was sent to at least one receiver). Suppose again that we can have very small total engagement rate numbers as long as the value does not reach zero. Then using the logic behind Reddy's Conduit Metaphor of Communication, the Axiom of Transitivity, and formal logic and Boolean mathematics' Transitive Implication or the Material Conditional with, we would come up with:

a = final engagement rate is greater than zero (at least one dividend variable [Reaction, Comment, Share] and at least one divisor variable [Fans or Shares] is denoted by a number greater than zero); let dividend be "1" and divisor is "3":

$$\left\{ \frac{[(+x_1) + (+c_1) + s] + [(+x_n) + (+c_n) + s]}{f + s} \right\} 100$$

$$\left\{ \frac{[(0) + (1) + 0] + [(0) + (0) + 0]}{3 + 0} \right\} 100$$

$$33.33 > 0$$

b = sender, message, and receiver are present

c = communication is present

And since $(a \Rightarrow b)$ (if " a ," then " b "; or " a " implies " b "), if final engagement rate is greater than zero (in this case, 33.33%), then that number above zero indicates the presence of sender, message, and receiver.

And since $(b \Rightarrow c)$ (if " b ," then " c "; or " b " implies " c "), if sender, message, and receiver are present, then communication is present.

And since $(a \Rightarrow c)$, then 33.33, a number above zero, indicates that communication is present.

However, if engagement values (Reactions, Comments, Shares, Fans) are all denoted by zero, $a \not\Rightarrow b$ (or there is no presence [there is an absence] of sender, message, and receiver) and $a \not\Rightarrow c$ (or there is no presence [there is an absence] of communication).

This Theorem can also be demonstrated in a truth table. Note that numbers in bold in Table 1 satisfy the conditions of each variable to make the " $a \Rightarrow c$ " transitivity. Note too, that the indicators are all numerical figures, which means that numbers represent the presence of communication. There is one sender and message (one Comment) represented by the number "1," and three receivers represented by the number "3" (three Facebook Fans). The variables of this study now take

the form of numerical figures, and the communication process associated with it now also take the form of numbers.

Table 1. Presence or Absence of Communication Truth Table

Dividend > 0			Divisor > 0		Engagement > 0	Engagement > 0 means communication is present
x	c	s	f	s		
0	1	0	3	0	$1 \div 3 \times 100 =$ $33.33 > 0$	✓
$A \Rightarrow B$ <i>If total of divisor and total of dividend are both numbers above zero ...</i>					$B \Rightarrow C$ <i>... and engagement above zero indicates the "presence of sender, message, receiver" ...</i>	$A \Rightarrow C$ <i>... then "presence of sender, message, receiver" means communication is present and represented by numbers greater than zero.</i>

SOURCE: Author.

Thus, any calculations represented by numerical figures that follow after the engagement rate calculations—such as the Ratio and the Index—would be numbers representing the presence of communication.

For this research, the Theorem demonstrating the presence of communication as represented by numbers was derived from Reddy's Conduit Metaphor of Communication, the Axiom of Transitivity, and formal logic and Boolean mathematics' Transitive Implication or the Material Conditional.

While transitivity axioms are widely used in various disciplines such as economics and mathematics, both logical and mathematical transitivity axioms (as well as Shannon and Weaver's communication model) were used in this research to create the Theorem specifically for communications applications and would apply in quantifying communication through social media engagement rates.

The Beginning and End of Communication. It is fortunate that Shannon and Weaver's model is simple, general (can be applied to many communication situations), and sees communication as a quantifiable process (Chandler, 2008). This lends the model a universal utility from which studies have sought to confirm not just the presence of a communication process among participants but the very existence of communication itself.

Juxtaposing Shannon and Weaver's model with the quantification methodology and Theorem of this study would look thus:

Table 2. Absence of Communication: Juxtaposed Social Media and Shannon-Weaver

								Equals NO presence of communication
Like	Love	Haha	Wow	Sad	Angry	Comment	Fans	
0	0	0	0	0	0	0	0	
Facebook as Encoder	 Source		Facebook as Transmitter	 Message		Facebook as Decoder	 Destination	Equals NO presence of communication
	0			0			0	

SOURCE: Author.

Yet, send at least one message, Comment, or Reaction through the complete cycle (including sender and receiver or Fans) and communication would begin:

Table 3. Presence of Communication: Juxtaposed Social Media and Shannon-Weaver

								Equals ✓ presence of communication
1	0	0	0	0	0	1	1	
Facebook as Encoder	 Source		Facebook as Transmitter	 Message		Facebook as Decoder	 Destination	Equals ✓ presence of communication
	1			1			1	

SOURCE: Author.

If “0” is a number that represents a state of absence of communication (because it cannot be defined) and a positive number above zero represents the presence of communication and social media engagement, then perhaps that point signals the start of communication and engagement. Conversely, as the numbers go higher, perhaps those infinitesimally huge numbers could represent active communication and engagement. As the numbers dwindle and slide down closer to zero, perhaps those numbers signal the end of the communication or engagement cycle. Communication begins with an initial engagement (a positive number no matter how small) and ends with the final engagement number, but it can never be zero engagement at all for there would be no communication to be observed in the first place. The presence of at least one sender, one message (Reaction or Comment, verbal or nonverbal), and one receiver is a prerequisite, and each of those variables is represented by at least “1.”

Although zero represents the absence of communication, not all variables of this study necessarily began with zero. When the Facebook page for this study was created, the online respondents (the online project proponents from U.P. Manila) were asked to first Like the page to become Fans of the page (otherwise they would not see any messages from the Facebook page). And so even before the offline respondents (the Aeta beneficiaries) began interacting, the Facebook page already had six (6) Fans (*f*), which is one of this study’s variables:

$$\pm E = \left[\frac{\sum(\pm e)}{f + s} \right] 100$$

$$\pm E = \left[\frac{\sum(\pm e)}{6 + s} \right] 100$$

Yet even though the divisor is “6,” if the dividend (either +e or -e) is zero, it would still return an indeterminate number (0 divided by 6 is indeterminate). And since +e and -e are engagement rates based on Comments, Reactions, and Shares, there must first be a comment or reaction before the communication process can begin so that +e or -e would not be zero.

That movement to a real number above zero is the start of engagement, the start of interaction, the start of message sending and receiving, and the start of communication. Communication may intensify and grow as engagement numbers also grow (more Comments, more Reactions, more Shares, more Fans), but once the numbers slide down, that would mean communication is waning as engagement numbers get smaller (in terms of proportion between positive and negative engagement) but never reaches zero since zero represents the absence of communication.

And so if we were to quantify communication using engagement rate proportions, any positive point just above zero—no matter how infinitesimally small as calculated using the Ratio—can represent either the beginning or the end of communication.

Step 6: Model and Construct the Spiral in 3D

Once the Index has been derived using numbers above zero, those numbers can then be represented visually. Those numbers—gathered from Day 1 to Day 5 of the research period—can be plotted as one-dimensional points on the “real line” (Benson, 1966). Along with the variable of time, those points (now called coordinates) could then be connected on the x and y axes to create lines on a two-dimensional plane. If we plot those real coefficients as numbers or as one-dimensional points, and then connect those points going up or down a line across a two-dimensional plane similar to the attempt of Flor (1984) to measure Kincaid’s (1979) convergence model, then project a mirror image of that

line, perhaps we would see a flat, two-dimensional image of the outline of a cone that contains the spiral.

Coordinates from a two-dimensional plane can be plotted across a three-dimensional Euclidean space (Benson, 1966). We can plot the two-dimensional lines 360 degrees on the x , y , and z axes of a three-dimensional Euclidean space. Plot those points across the x , y , and z axes and we would see the funnel containing the spiral in three dimensions (Thurston and Levy, 1997). This process of “pushing out” points on a plane to 3D space is known in the 3D animation and modeling industries as “extrusion” (De Cambray, 1993).

In computer-based 3D modeling, extrusion is a function of depth sensing and processing. While geometric 3D modeling of the depth field becomes complex when mixed with variables such as perspective and projection (Krig, 2014), our model of the Spiral of Silence is less complicated because two of the three coordinates are already joined together as one on the two-dimensional plane. These are the x and y axes, which together represent the value of (i) the Index (ii) at a certain point in time. The only thing left as a requirement for mapping across the depth field is to “extrude” those conjoined values and project them across the third dimension (on the z -axis) equidistantly from the point of origin (Lagarias, et al., 2002).

The steps detailed above are basic foundations of 3D modeling for the animation, computer-aided design, and geographic information systems industries (De Cambray, 1993). They are based on the following geometrical and spatial axioms and postulates of Euclid:

► First Euclidean Postulate: “To draw a line from any point to any point.” This allows us to connect a point to another point on a one-dimensional line, such as the engagement rate data on the x -axis. The five numbers produced over five days as a result of the Ratio and the Index can be individually plotted as points on the one-dimensional real line or the set of real numbers ordered from least to greatest, viewed as a uni-dimensional geometric space. This is denoted by R^1 or the Euclidean space of dimension one on the x -axis (Deza and Deza, 2009). This postulate also allows us to connect a point on the x -axis to another point on the y -axis. Points x and y now become coordinates or ordered pairs on a two-dimensional plane or Euclid’s R^2 (Benson, 1966).

► First Euclidean Axiom: “Things which are equal to the same thing are also equal to one another.” This allows us to project mirror images of a point or a line as long as those two points (and consequently, the lines

created by those points) are of equal distance from the point of origin. The point of origin on R^1 is "0" while the point of origin on R^2 are the coordinates "0, 0" (Benson, 1966).

► Third Euclidean Postulate: "To describe a circle with any center and distance." This allows us to project mirror images of points and their resulting lines 360 degrees around the point of origin on Euclid's third dimension of space, forming a perfect circle whose sides are equidistant around the point of origin (the center). Every point in three-dimensional Euclidean space is determined by three coordinates (x , y , and z), and if those points are equidistant from the coordinates "0, 0, 0" (the point of origin on R^3), they would form a perfect circle when projected 360 degrees on 3D space (Thurston and Levy, 1997).

Logical Assumptions Made

In summary and based on existing theories, hypotheses, axioms, postulates, and theorems from the fields of mathematics, formal logic, and communication, we have made logical assumptions in this study such as:

- when a majority opinion becomes dominant, a minority is silenced
- to measure that dominance against silence, we need to find the opinion gap
- social media metrics are already being used to measure engagement, interaction, and agreement/disagreement with content
- an equation to determine social media engagement already exists; it can be modified to measure gaps between positive and negative engagement
- positive/negative engagement gap = minority/majority opinion gap
- using this study's modified engagement rate calculator, the positive/negative and minority/majority opinion gap can be measured
- the Equation can be used to represent that gap through a Ratio
- the Ratio can be used to derive a baseline Index
- the Index is a single numerical figure that describes the size of the opinion gap
- opinion gaps fluctuate over time till minority/majority opinions take hold
- opinion gap sizes can be plotted through the variable of "time"
- two variables can be plotted across Euclid's line and plane axioms
- Euclidean space becomes Cartesian space when (3) coordinates are used together
- Euclidean and Cartesian axioms and postulates are used in 3D

animation, CGI, GIS, and CAD to convert R^1 , R^2 , and R^3 to 3D using “extrusion”

- ▶ the same method and principles above can be used to create perfect circles based on the joint x and y coordinates mapped on the z -axis
- ▶ the perfect circles mentioned above can be stacked on top of each other because of the variable of time
- ▶ a wireframe outline can be wrapped around the 3D image produced by the method above
- ▶ the wireframe can show the outline of a funnel, a cylinder, or a cone depending on the values extruded and based on the data gathered
- ▶ this study's Index results can be used as modeling data and plotted across time and space as defined by Euclid and Descartes; that data can be used as plotting points for the wireframe outline described above
- ▶ a helix or a spiral can be drawn inside the wireframe funnel created
- ▶ the method above allows us to model and see the spiral in 3D.

Chapter Nine

OPERATIONAL METHODOLOGY, DATA GATHERING, AND ANALYSIS

In accordance with the Conceptual Methodology and Framework, this research followed and operationalized the same six steps outlined in the previous chapter when the small-scale pilot test entered the data gathering and analysis phases.

Step 1: Create a Hybrid Social Media Environment

This study required the creation of a controlled social media environment where stakeholder-respondents of a development project in the Philippines were invited to a Facebook Community Page. The page called “Help Us Develop” was created by the researcher and can be accessed at <https://www.facebook.com/helpusdevelop/> with the following disclaimer on the cover page, in the spirit of transparency:

“This page allows you to state which sector you think needs development assistance. This page is part of an ongoing study on communication.”

And a more detailed note in the “About” section of the page:

“Kindly React, Share, or Comment on the question on this page. Tell us which sector you think should get more development aid. This page is part of an ongoing study on development communication and your inputs would truly be appreciated.”

It must be reiterated that—in accordance with this study’s objective—the focus is to first pilot test the conceptual Methodology (Steps 1 to 6) on a small-scale project then invite other researchers to test the Methodology further on other projects larger in scale and scope.

The project chosen for the pilot test was the Indigenous Knowledge Systems and Practices (IKSP) program and its auxiliary project called Lupungan, a local term for “meeting place.” IKSP is a project at the Loob-Bunga Aeta resettlement area in Barangays Palis and Moraza in the Municipality of Botolan, Zambales. Meanwhile, Lupungan is a social laboratory of U.P. Manila to train behavioral science students on (i) immersing with the Aeta community, (ii) promoting awareness and at the

same time documenting the Aeta culture and tradition for preservation, and (iii) promoting the IKSP program.

The study of the IKSP and Lupungan social laboratory served as a platform on which the Methodology could be pilot tested from the conceptual to the operational (which is why this research has both “conceptual methodology” and “operational methodology” chapters). Operationalizing the Methodology on larger and more comprehensive studies is recommended to validate the Methodology itself, not necessarily to derive more conclusive results from the particular pilot test at hand. By so doing, we might see more comprehensive and more accurate measurements and models of the Spiral of Silence in 3D.

Aside from assisting the Aeta community in livelihood opportunities, the IKSP project intends to document history, culture and arts, local history, and local know-how in order to preserve, protect, and promote the indigenous identity of Sambal Aetas. The project seeks to examine:

- (i) the area as a place to live, including the quality of the environment and the Sambal Aeta’s attitudes toward living there (ethnohistory and spatial mapping);
- (ii) the area as a personal space—the degree of attachment that Sambal Aeta have in their area; memories and life experiences of Aetas (ethnopsychology);
- (iii) the area as a social community, including indigenous groups’ involvement in the social life of the community;
- (iv) the area as a cultural community where Sambal Aetas are cultural actors who constantly negotiate their cultural identity;
- (v) the area as a political community, including systems and structures of political representation and local area management;
- (vi) the area as an economic community, including sources of income and institutional programs for the Sambal Aetas;
- (vii) the degree of involvement in local decision making; and
- (viii) the specific local identity that differentiates the community.

The project beneficiaries are members of the Sambal Aeta community (residents and officials of the local government unit [LGU]) displaced by

the eruption of Mount Pinatubo in 1991 who were transferred to the Loob-Bunga resettlement area. The project proponents are the U.P. Manila behavioral science professors and students who executed the project. The IKSP is funded by the university and donors acting in their personal capacities. Since respondents were either proponents or beneficiaries, they are collectively called in this study as stakeholder-respondents.

The engagement period and data gathering lasted five days (25 to 29 November 2016). A question was posted on the Help Us Develop Facebook Community Page, asking whether or not the stakeholder-respondents agreed with agriculture receiving majority of the development budget, while education was receiving much less. The stakeholder-respondents were asked to choose between agriculture and education as a development priority and to explain why. They were also asked to interact with other Facebook stakeholder-respondents. Online engagement was purely voluntary.

The exercise was initiated by inviting the online, Manila-based stakeholder-respondents to join the Help Us Develop Community Page using their own Facebook accounts. The administrator account of the Help Us Develop page was used to input replies from the Aeta beneficiaries who did not have Facebook accounts. All offline comments were made voluntarily. In the Comments section, the Aeta beneficiaries' names were displayed in capital letters so that the online respondents would know who was making the offline comment. Feedback was then gathered from the online U.P. Manila respondents then fed back to the Aetas the next day (responses on Facebook were shown to the Aetas either as screen captures on a laptop or as printouts). This back-and-forth process was done on a daily basis.

Of the 10 Aeta beneficiaries, 9 of them saw Facebook for the first time (from an offline laptop and printouts brought to the field). Only one of them (the only one who reached high school) had seen Facebook before but had never tried it himself.

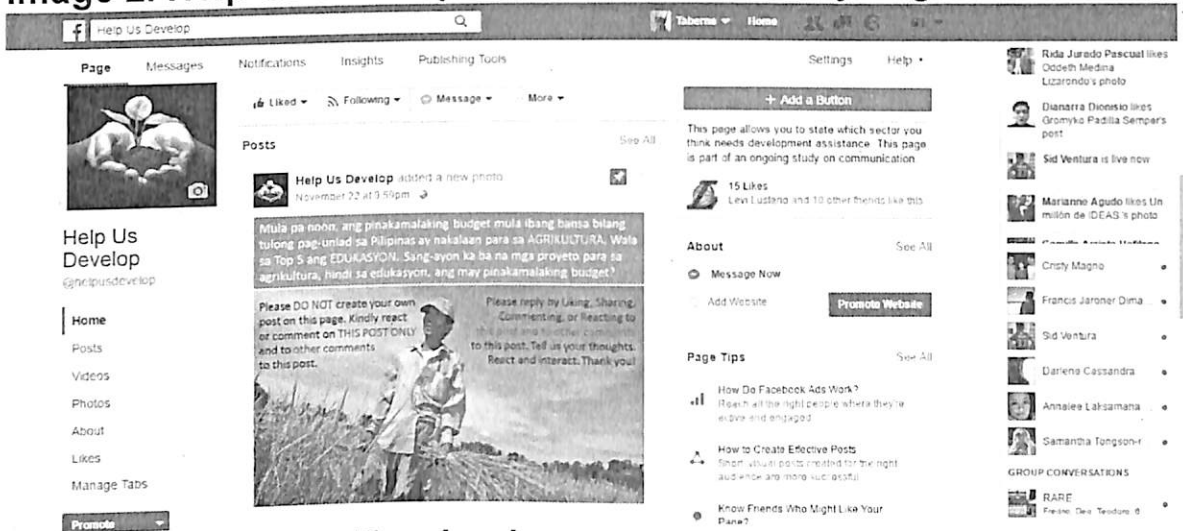
This study thus used a hybrid online-offline environment to gather data. Facebook was used in this research merely as an electronic survey and interaction forum for the purpose of gathering engagement data and calculating those data using the Equation. What was important was for the interaction values to be fed into the engagement rate Equation, regardless whether those interactions were done online or offline. And since this study extracts Facebook's formula for engagement and then concretizes

it as an Equation for use even when offline, the Facebook page itself was utilized as a hybrid online-offline data gathering medium.

Data analysis and the rest of the process were done offline using the Equation. The objective was to see how much positive and negative engagement the topic and question would receive (signifying agreement or disagreement with the topic) and then observe how minority-majority dynamics would transpire.

The question regarding agriculture and education development budget was posted on the Facebook page to begin the discussion. It was worded simply enough such that it would elicit a simple either-or reaction. All stakeholder-respondents were encouraged to share their opinions in the Facebook Community Page, as well as voluntarily Liking, Sharing, or Reacting to the posts of others.

Image 2. Help Us Develop Facebook Community Page Main Post



SOURCES: Author, Facebook.

The language used was the lingua franca (Filipino), the common language among the stakeholder-respondents. The question, accompanied by a photo of a farmer, was:

“Ang pinakamalaking budget mula ibang bansa bilang tulong pag-unlad sa Pilipinas ay nakalaan para sa agrikultura. Sang-ayon ka ba na mga proyekto para sa agrikultura, hindi sa edukasyon, ang may mas malaking budget?”

In English: “Much of the foreign development aid budget to the Philippines is allocated for agriculture. Do you agree that projects for agriculture, not education, should get more development funding?”

The stakeholder-respondents were essentially asked to choose between agriculture and education as a development aid priority. The question became the first and only “main post” on the Facebook page and the only post that came from the Facebook page administrator, who was also the researcher. The rest were Comments in reaction to that post from the stakeholder-respondents. The respondents were asked to voluntarily reply to the question as posted on Facebook and not to create a new post of their own.

Having only one photo and post (the question of whether agriculture or education should get the bigger development budget) was done to keep the discussion focused on a single topic and to organize data tabulation. Doing so also ensured that the correct metrics would be counted. These metrics were the number of Reactions, Comments, Shares, and Reach on Facebook, which collectively and as shown by the Equation, form the engagement rate of posts and discussions on the page.

The page, however, was not a Secret or Closed Facebook group (otherwise, the main topic or post would not get Shared). Although the Help Us Develop Community Page was by invitation, Facebook users may still “stumble upon” the page and even leave a Comment. Such Comments not coming from the stakeholder-respondents were promptly deleted, although others were allowed to become Fans of the page.

Secret and Closed Facebook groups are those whose contents are visible only to group members who were invited to Like the Facebook page, and they are the only ones who can interact with other members in the group. This way, non-participants cannot join the discussion and paid posts that appear on Facebook’s news feed will not appear in the closed group. However, despite being by invitation, the Facebook Community Page created for this study still allowed members—stakeholder-participants of the development project pilot test—to Share posts to the public via their respective Facebook accounts. Those posts can then be seen and Shared by the stakeholder-respondents’ friends, and their friends can share the post as well and so on and so forth due to the multi-nodal power of social networks. This is the study’s word-of-mouth or “ripple” analog in the advertising industry.

The word-of-mouth factor (Withaar, et al., 2013) translated through the Equation would equate to the Facebook post’s Reach. Whereas Withaar,

et al. refer to these indicators as word-of-mouth, and others refer to them as “conversation and amplification rates,” (TrueSocialMedia, 2015) for the Equation this was the total number of people who saw the post through the combined variables of Fans and Shares (collectively referred to as Reach in this study).

The Facebook page thus served as a forum dedicated to a discussion on that specific development topic in which only online and offline stakeholder-respondents participated since they were the only ones invited. It thus satisfied the first step of the Methodology, which was to create a hybrid social media environment for the study.

Step 2: Log and Quantify the Results Using the Equation

This study used a hybrid online-offline data gathering method to mitigate the disadvantages of the digital divide. Facebook’s Insights analytics feature was not used in this study to gather data, except for the number of Shares to friends of Fans and friends of friends across the Facebook social network which could not be counted manually. The number of Fans was also indicated on the page. All Reactions and Comments were counted manually, whether online or offline.

Stakeholder-respondents comprised (i) online U.P. Manila students and professors who were also the project executors and proponents (P) and (ii) the offline Aeta community composed of the LGU and residents (B).

The composition of participants and the even dichotomy among the stakeholder-respondents made the IKSP project an ideal pilot test. The program was chosen for the pilot test due to the dichotomy between and among the stakeholder-respondents, namely: (i) a 50% split between genders, (ii) a 50% split between project beneficiaries and project proponents, (iii) a 50% split between those who use Facebook and those who do not (online-offline dichotomy), (iv) a 50% split between those who have attended undergraduate or postgraduate programs and those who have not, (v) a 50% split between farmers and those in education, (vi) a 50% split between urban and rural residents, (vii) a 50% split between ordinary homeowners and representatives of the local government (for the beneficiaries), and (viii) a mix between students and professors (for the proponents).

The two sets of stakeholder-respondents were represented equally. There were 10 project proponents (P1 to P10) and 10 project beneficiaries (B1

to B10), the details of whom are listed in Table 4 (note that the respondents agreed to have their details listed).

Table 4. List and Identification Tags of Stakeholder-Respondents

ID#	Name	Age	Gender	Educational Attainment	Residence
B1	Aga Basa	33	F	Grade 3	Botolan, Zambales
B2	Ronald Basa	35	M	Grade 1	Botolan, Zambales
B3	Manuel dela Cruz	32	M	Grade 4	Botolan, Zambales
B4	Lilia dela Cruz	39	F	Grade 6	Botolan, Zambales
B5	Sotero dela Cruz	36	M	Grade 6	Botolan, Zambales
B6	Lito dela Cruz	43	M	Grade 6	Botolan, Zambales
B7	Arnold dela Cruz	44	M	Grade 2	Botolan, Zambales
B8	Robert David	24	M	3rd year high school	Botolan, Zambales
B9	Marites dela Cruz	23	F	Grade 4	Botolan, Zambales
B10	Tirso dela Cruz	34	M	Grade 1	Botolan, Zambales
P1	Isabel Jiao	20	F	4th year college	Quezon City

P2	Bianca Liwag	21	F	4th year college	Bacoar, Cavite
P3	Therese Ong	20	F	4th year college	Quezon City
P4	Amy Afable	38	F	PhD candidate	General Trias, Cavite
P5	Enrico Baula	40	M	PhD candidate	Batasan, Quezon City
P6	Lalaine Quinan	21	F	4th year college	Pasay City
P7	Norman King	28	M	4th year college	Porac, Pampanga
P8	Emerson Arenas	28	M	3rd year college	Manila
P9	Tess de Guzman	50	F	PhD in Anthropology	Fairview, Quezon City
P10	Kara Liangco	19	F	4th year college	Sta. Rosa, Laguna

SOURCE: Author.

The project proponents (students and teachers) were briefed in person at U.P. Manila four days before data gathering began in Zambales, while the Aeta beneficiaries were briefed via cellular phone and through the students who went on site before the research began. Communications were done through the LGU who then met with the residents before fieldwork started. The stakeholder-respondents were made aware that they were to become part of an ongoing academic research.

The study's rationale and objectives were also made known to them. Through the students, the local barangay officials were made aware of the researcher's arrival and intentions before actually visiting the project site.

All efforts were made for this research to comply with the American Psychological Association's Ethical Principles and Code of Conduct for Research and Publication (APA, 2010).

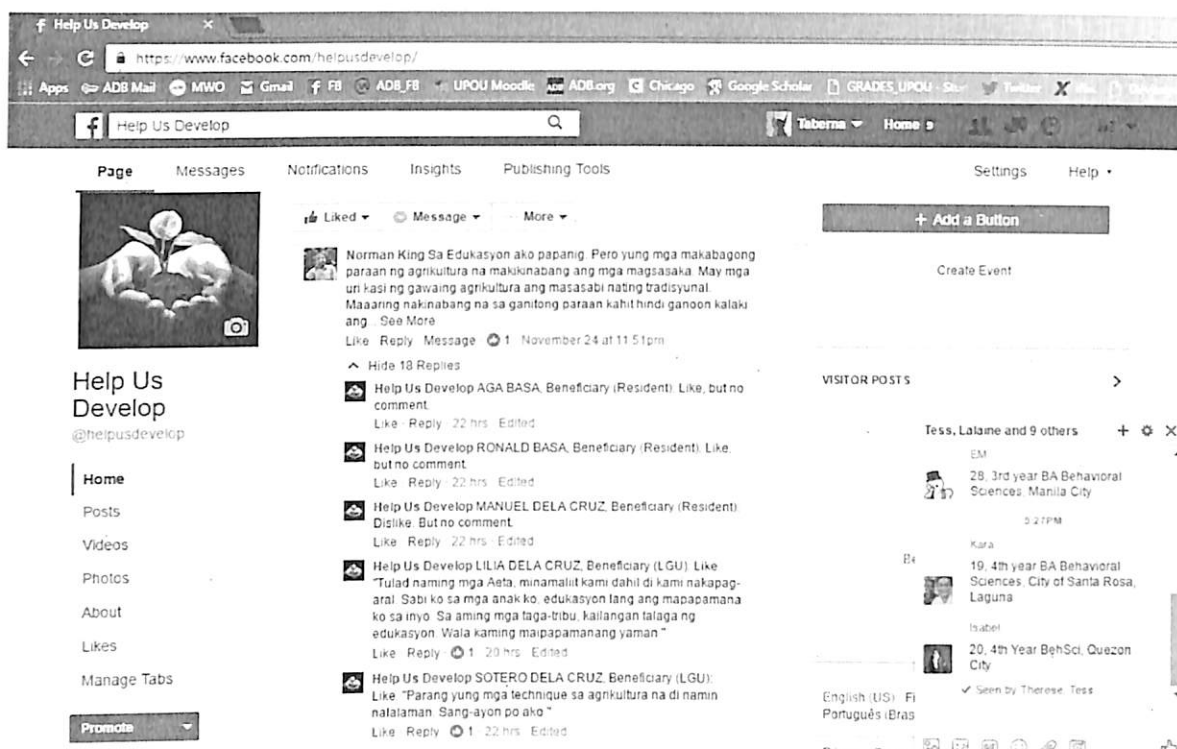
On 25 November 2016, Day 1 of interaction, only stakeholder-respondents from the online proponents' group in Manila were active, as they were asked to initiate the discussion which they found easy to do since they were online. The Aeta beneficiaries responded on Day 2. All interactions or engagement were logged on a daily basis.

The stakeholder-respondents were encouraged to engage, interact, agree, or disagree with each other. They were asked to voluntarily Like, React to, Comment, or Share (in the case of online respondents) any of the other comments on the Help Us Develop Facebook Community Page, along with a short explanation of their position about the issue, if any. Posts from stakeholder-respondents then became visible on the page's News Feed. Duplicate posts were promptly deleted (a glitch that sometimes happens on Facebook).

Since data was gathered from a hybrid online-offline environment, both nonverbal and verbal cues were employed to determine the stakeholder-respondents' agreement or disagreement with the question posed online. Such nonverbal and verbal cues were this study's analogs of Facebook's Reaction buttons ("Like," "Love," "Haha," "Wow," "Sad," and "Angry").

This exercise was performed only for the 10 offline Aeta beneficiaries in the resettlement area as the other 10 respondents were online using Facebook. In Image 3, note the words "Like" or "Dislike" in the comments. These were inputted using the "Help Us Develop" administrator account on behalf of Aeta respondents whose names were written in capital letters to let the online proponents know who was reacting. The "Likes" or "Dislikes" from the 10 offline Aeta beneficiaries were tallied based on verbal and nonverbal cues (see Table 5) observed physically and recorded from the field (see Image 6).

Image 3. Help Us Develop Respondent Replies



SOURCES: Author, Facebook.

In place of Facebook's Reactions, this research borrowed from Bousmalis, et al.'s (2009) Table of Cues of Agreement and Disagreement in their study on how to recognize nonverbal and audiovisual cues of agreement or disagreement made specifically for computer-based communication. This study's modified version of Bousmalis, et al.'s table counts head gestures (e.g., nod or head shake), facial actions (e.g., smile or frown), verbal cues (agreement words, e.g., "OK," "Tama," "Aprub," "Ayoko"), and gestural cues (e.g., thumbs up sign). Bousmalis, et al.'s original table contains more nonverbal cues such as body posture (e.g., slackened shoulders, leaning sideways), audiovisual and vocal cues (e.g., laughter, sigh, snicker), and gestural cues (e.g., thumbs up, waving of hand in dismissal) as signals of agreement or disagreement with a topic.

For this study, however, offline respondents who participated gave both verbal and nonverbal cues of agreement or disagreement when they were shown printouts or screenshots of the Facebook page, making their stance clear whether they were for development of agriculture or education. No ambiguity was recorded.

Table 5 shows the verbal and nonverbal cues recorded from the Aeta beneficiaries when they were shown offline printouts and screenshots of Facebook comments from their online counterparts from U.P. Manila.

Table 5. Nonverbal and Verbal Cues Recorded

ID#	Positive Verbal	Positive Nonverbal	Negative Verbal	Negative Nonverbal
B1	5 (OK yan)		5 (ayoko)	2 (head shake)
B2	3 (tama siya)	1 (nod)	8 (hindi maganda yan)	1 (head shake)
B3	9 (OK yan, tama yan)		3 (ayaw ko yata yan)	1 (frown)
B4	2 (aprub)	1 (thumbs up)	4 (mali po yata yan)	2 (head shake)
B5	4 (OK, tama yan)		11 (ayoko niyan)	
B6	4 (OK yan)		12 (di ako sang-ayon)	
B7	9 (OK, tama yan)		4 (ayaw ko niyan)	
B8	4 (OK, tama, gusto ko)		11 (di po maganda yan)	1 (head shake)
B9	2 (sang-ayon ako)	1 (thumbs up)	8 (di ako sang-ayon)	2 (head shake)
B10	2 (OK po yan)	1 (nod)	9 (di po maganda yan)	

SOURCE: Author.

These reactions were then recorded in the tally sheet under either the positive or the negative Reactions columns as part of the computation for engagement with the topic. Positive engagement translated to agreement that agriculture should get more budget, while negative engagement translated to agreement that education should get more development budget. Any comments from the Aeta respondents were written on paper, then later on inputted into the Help Us Develop Facebook Community Page. Offline field responses from the Aeta beneficiaries were manually gathered from the mountains then inputted online daily before midnight where Internet connection was available (about an hour from the Loob-Bunga resettlement area). The Facebook account used was that of the Help Us Develop page administrator, but with the names of the respondents written in capital letters so that all participants would know who was making the comment.

Image 4. Facebook Replies Shown Via Computer (left) and via Printouts (right)

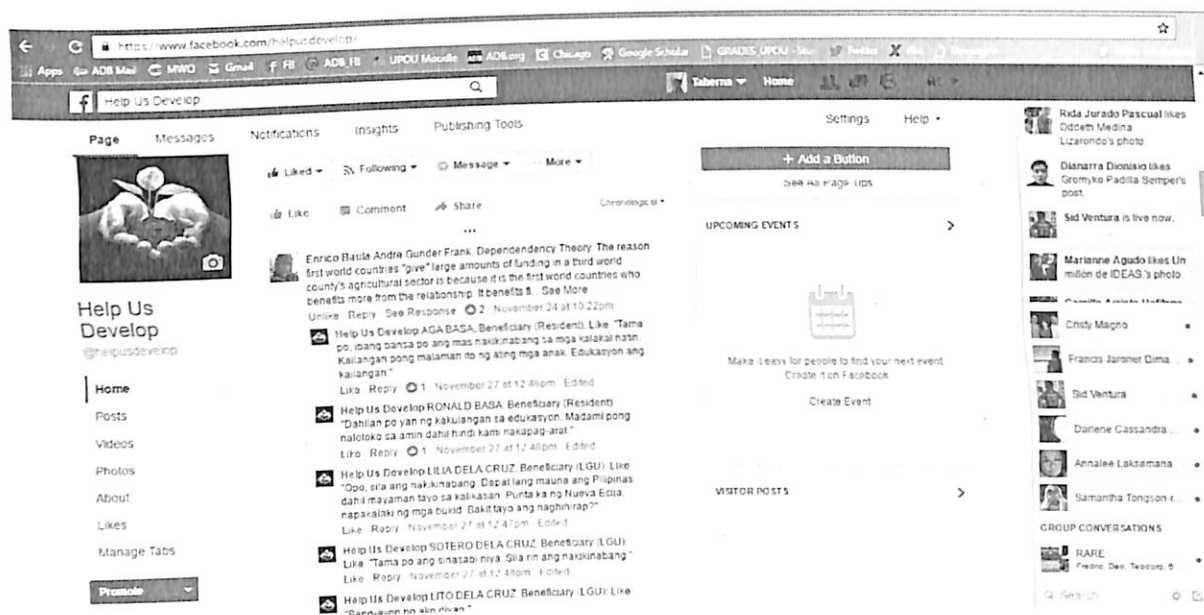


SOURCE: Author.

The indicators of engagement from the Aeta beneficiaries were seen as posts by the online respondents in Manila who then saw the beneficiary feedback from the Loob-Bunga resettlement area respondents. Feedback was then given by the online proponents in Manila. Those feedback from Manila were again shown offline to the Aetas of Barangays Palis and Moraza and so on and so forth—once a day—until the data gathering

period was over. The back-and-forth interactions, or the data gathering period among stakeholder-respondents, lasted five days. Tallying was done on a daily basis (cut-off time was 12 midnight every day). Facebook-based responses that arrived after midnight were counted for the next day.

Image 5. Offline Aeta Beneficiary Responses Posted Manually on Facebook

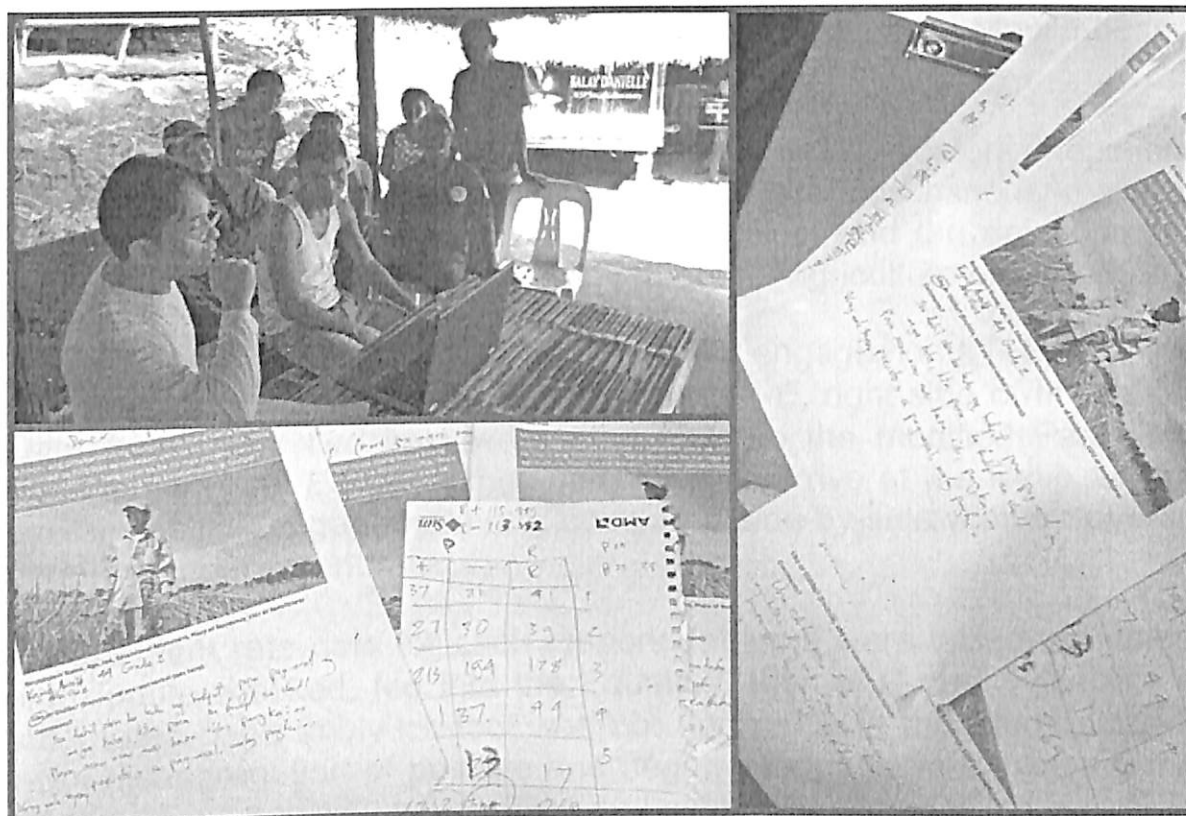


SOURCES: Author, Facebook.

After data gathering, the required variables were tallied.

Aside from Comments and Reactions, Shares plus Fans (collectively called Reach) were part of the measurement parameters of the Equation as Shares show an effort to make the posts known by others. Reactions, Shares, and Comments are useful in furthering an advocacy post since (i) they show an effort and a certain degree of conviction that the post is worthy of being posted at all and (ii) comments and reactions thicken the discussion about the original post. Thus, the original post is seen or “amplified” by more people through Liking, Reacting to, Commenting, and Sharing.

Image 6. Actual Tally Sheets Based on Offline Field Data



SOURCE: Author.

Collectively, all these metrics were calculated to derive the engagement rate of each stakeholder-respondent, disaggregated from the other participants.

Consequently, the Facebook Community Page needed to be filtered for relevance for the metrics to be valid, and this filtering process meant that the Facebook page had to be moderated by the researcher. This was done to increase the validity of the data gathered from the Facebook page.

Engagement simulates real-world discussion and interaction on social media. The Spiral of Silence Theory posits that people match their opinions with discussions displayed in public (the opinion climate).

In the case of the Facebook Community Page for the pilot test, the members of whom were invited by this researcher, that “public” and “opinion climate” is the “within-forum” climate of opinion of Nekmat and Gonzenbach (2013), not the opinion climate generated by the general public or media as defined by Noelle-Neumann. In the IKSP pilot test, that

"within-forum" opinion climate would include the discussions in the Facebook Community Page, real-world discussions among the Aetas, online and real-world communications among the Manila-based participants, and possibly Internet or Google searches.

We are considering the engagement rate actions as indicators of opinion. We are establishing relationships between Facebook minority-majority interactions and their opinions about the project and the development topic of discussion (development aid budget for agriculture or education).

Two sets of data were gathered: the positive engagements (+ E , left side of the ratio) and the negative engagements (- E , right side of the ratio). Data from these two sets were then fed into the modified Facebook engagement rate Equation then calculated to arrive at the Ratio, or the overall positive engagement rate compared side-by-side with the overall negative engagement rate.

Engagement rate data for each respondent input were tallied, validated and double-checked, fed into the Equation, then analyzed. Facebook's automated page analytics tool was not applicable in this study since it lacks disaggregation of positive and negative engagement. Instead, the modified Equation was used offline and manually using a calculator.

Table 6 shows the raw daily tally sheet filled in at midnight on every day of the five-day data gathering period. It shows raw interaction data gathered from the online project proponents from U.P. Manila and from the offline Aetas surveyed on the field, where + x is a positive Reaction, + c is a positive Comment, - x is a negative Reaction, and - c is a negative Comment.

Note that f and s are counted only once—at the top of each day's row and not registered per respondent—because those numbers already show the total number of Fans and Shares per day. Stakeholder-respondent replies (P1 to P10 and B1 to B10) are not in numerical sequence since data was recorded according to who registered an engagement first.

Table 6. Raw Tally Sheet

+x	+c	# of Shares	# of Fans	Respondent ID#	-x	-c	# of Shares	# of Fans
DAY 1								
		27	14	P1	1		27	14
1				P2				
1				P3				
1				P4				
1				P5				
1				P6				
1				P7				
				P5		1		
	1			P7				
	1			P7				
	1			P7				
	1			P7				
				P7		1		
				P7		1		
DAY 2								
		24	15	P8	1		24	15
1	1			P9				
	1			P9				
				P6	2	1		

				P10	1	1		
1	1			B1	1	1		
1	1			B2	1	1		
1	1			B3	1	1		
				B4	1	1		
				B5	1	1		
				B6	1	1		
				B7	1	1		
DAY 3								
1	1	113	15	P5	7	8	113	15
2	1			P7	9	4		
10	9			P7				
7	7			P7	1	1		
8	7			P7	2	1		
10	8			P7				
2	1			P7	5	3		
4	3			P9	6	6		
9	7			P9	1	1		
				P6	6	5		
2	1			P10	8	7		
4				B1	6	3		
3	3			B2	8	3		

8	8			B3	2			
3	9			B4	3	9		
4	3			B5	8	6		
4	3			B6	7	5		
9	8			B7				
4	4			B8	7	7		
3	3			B9	8	8		
3	3			B10	9	6		
DAY 4								
		29	15	P7		1	29	15
				P7		1		
				P7		1		
				P7		1		
				P7		1		
	1			P7				
	1			P7				
				P7		1		
				P7		1		
				P7		1		
				B5	1			
				B6	1			
				B7	1			

				B8	1			
				B9	1			
DAY 5								
		2	15	B6	1	1	2	15
				B7	1	1		
				B8	1	1		
				B5	1			
				B9	1			
	1			P7	1			
	1			P7	1			
				P7	1	1		
				P7	1	1		
				P7	1	1		
				B6	1	1		
				B6	1	1		
				B4	2	1		
				B8	1	1		
				B8	1	1		
				B8	1	1		
				B7	1	1		
				P10	2	1		

SOURCE: Author.

Step 3: Determine the Final Engagement Ratio and the Index

We now need to get values for +e and -e, the daily summation of positive and negative engagement (dividend), and the daily summation *f* and *s* or Reach (divisor).

$$\Sigma(+e) = \sum_{i=+e_1}^n +e_i$$

$$\Sigma(-e) = \sum_{i=-e_1}^n -e_i$$

For the dividend: All positive Reactions (+x), positive Comments (+c), and Shares for that day were added per stakeholder-respondent to get +e. All negative Reactions (-x), negative Comments (-c), and Shares for that day were added per stakeholder-respondent to get -e.

$$[(\pm x_1) + (\pm c_1) + s] + [(\pm x_n) + (\pm c_n) + s]$$

Where:

$\pm x_1$ = the first positive or negative Reaction in the set of *x*

$\pm x_n$ = the last positive or negative Reaction in the set of *x* (summation index calculates first to last values)

$\pm c_1$ = the first positive or negative Comment in the set of *c*

$\pm c_n$ = the last positive or negative Comment in the set of *c* (summation index calculates first to last values)

s = the number of Shares of the original post (the question) for that day

$$+E = \left[\frac{\Sigma(+e)}{f + s} \right] 100$$

$$-E = \left[\frac{\sum(-e)}{f + s} \right] 100$$

$$R = f + s$$

For the divisor: All Fans (*f*) and Shares (*s*) per day were added (for both positive and negative engagement) to get the Reach (*R*). Table 7 shows the daily summation of the variables.

Table 7. Daily Summation of Variables (Dividends and Divisors)

+e (x+c+s)	Fans + Shares (R)	Respondent ID#	-e (x+c+s)	Fans + Shares (R)
DAY 1				
27	41	P1	28	41
1		P2		
1		P3		
1		P4		
1		P5		
1		P6		
1		P7		
		P5	1	
1		P7		
1		P7		
1		P7		
1		P7		
		P7	1	

		P7	1	
DAY 2				
24	39	P8	25	39
2		P9		
1		P9		
		P6	3	
		P10	2	
2		B1	2	
2		B2	2	
2		B3	2	
		B4	2	
		B5	2	
		B6	2	
		B7	2	
DAY 3				
115	128	P5	128	128
3		P7	13	
19		P7		
14		P7	2	
15		P7	3	
18		P7		
3		P7	8	

7		P9	12	
16		P9	2	
		P6	11	
3		P10	15	
4		B1	9	
6		B2	11	
16		B3	2	
12		B4	12	
7		B5	14	
7		B6	12	
17		B7		
8		B8	14	
6		B9	16	
6		B10	15	
DAY 4				
29	44	P7	30	44
		P7	1	
		P7	1	
		P7	1	
		P7	1	
1		P7		
1		P7		

		P7	1	
		P7	1	
		P7	1	
		B5	1	
		B6	1	
		B7	1	
		B8	1	
		B9	1	
DAY 5				
2	17	B6	4	17
		B7	2	
		B8	2	
		B5	1	
		B9	1	
1		P7	1	
1		P7	1	
		P7	2	
		P7	2	
		P7	2	
		B6	2	
		B6	2	
		B4	3	

		B8	2	
		B8	2	
		B8	2	
		B7	2	
		P10	3	

SOURCE: Author.

We now need to divide the daily summation of Reactions, Comments, and Shares (the dividend, $+e$ and $-e$) by the summation of Fans and Shares (R , the divisor) for both positive and negative engagement. The resulting Ratio (opinion incongruence gap) is denoted by:

$$+E : -E$$

Where:

$+E$ = total positive engagement rates

$-E$ = total negative engagement rates

The resulting Index (used later to measure the size and model the shape of the Spiral of Silence) is obtained by dividing one by the other:

$$\frac{+E}{-E}$$

This will give us the total daily positive engagement ($+E$) and the total daily negative engagement ($-E$). That data is summarized in Table 8.

Table 8. Summarized Raw Daily Data

DAY	+e	R	<i>Positive Engagement (+E)</i>	-e	R	<i>Negative Engagement (-E)</i>
1	37	41	90.243	31	41	75.609
2	33	39	84.615	44	39	112.820
3	302	128	235.937	299	128	233.593
4	31	44	70.454	42	44	95.454
5	4	17	23.529	36	17	211.764

SOURCE: Author.

Step 4: Tabulate Numbers Needed to Visualize the Spiral's Size

Table 9 shows the data after running figures from Table 8 through the Equation, with the raw daily calculation on the left side and the final, simplified daily ratio on the right. The raw daily positive and negative results are used to derive the Index (divide positive engagement by the negative engagement to convert the ratio into a single numeral), while the simplified data or final daily engagement is the final daily Ratio, rounded off to the lowest prime number. The Index figures are used to model the size and shape of the Spiral of Silence.

Table 9. Raw and Simplified (Final) Daily Engagement Rates, Ratio, and Index

DAY	Raw Daily (+) Engagement	Raw Daily (-) Engagement	Ratio	Index
1	90.243	75.609	6 : 5	1.193
2	84.615	112.820	3 : 4	0.750
3	235.937	233.593	24 : 23	1.010
4	70.454	95.454	5 : 6	0.738
5	23.529	211.764	3 : 26	0.111

SOURCE: Author.

We can also get the total five-day engagement numbers without disaggregating the figures on a daily basis. The formula is the same; we simply do not disaggregate by day (and thus we do not repeat the number of Fans):

$$+E = \left[\frac{\sum(+e)}{f + s} \right] 100$$

$$-E = \left[\frac{\sum(-e)}{f + s} \right] 100$$

This is obtained by adding the number of positive and negative engagements (Reactions, Comments, and Shares) from all five days to get the dividend. For positive engagement for all five days, the total is 407. For negative engagement for all five days, the total is 452. The divisor is the number of Shares for all five days plus the number of Fans (15) on the fifth and last day, which applies to all five days of the study. For both positive and negative engagement, the divisor is the same at 210 (195 Shares plus 15 Fans). Thus:

$$\text{Five Day} + E = \left[\frac{407}{210} \right] 100$$

$$\text{Five Day} - E = \left[\frac{452}{210} \right] 100$$

And thus:

$$\text{Five Day} + E = 193.809$$

$$\text{Five Day} - E = 215.238$$

Table 10. Total Five-Day Engagement Rates, Ratio, and Index

Five-Day +E	Five-Day -E	Five-Day Ratio	Five-Day Index
193.809	215.238	9 : 10	0.900

SOURCE: Author.

The full Equation for the Ratio is shown below:

$$\text{Ratio} = +E : -E$$

$$\left\{ \left[\frac{\sum(+e)}{R} \right] 100 \right\} : \left\{ \left[\frac{\sum(-e)}{R} \right] 100 \right\}$$

$$+E = \left[\frac{\sum(+e)}{f + s} \right] 100$$

$$-E = \left[\frac{\sum(-e)}{f + s} \right] 100$$

$$\Sigma(+e) = \sum_{i=+e_1}^n +e_i$$

$$\Sigma(-e) = \sum_{i=-e_1}^n -e_i$$

$$R = f + s$$

The more detailed Equation containing all variables is shown below:

$$\left(\left\{ \frac{[(+x_1) + (+c_1) + s] + [(+x_n) + (+c_n) + s]}{f + s} \right\} 100 \right) : \left(\left\{ \frac{[(-x_1) + (-c_1) + s] + [(-x_n) + (-c_n) + s]}{f + s} \right\} 100 \right)$$

Where:

$+x_1$ = the first positive Reaction in the set of $+x$

$+x_n$ = the last positive Reaction in the set of $+x$ (summation index calculates first to last values)

$-x_1$ = the first negative Reaction in the set of $-x$

$-x_n$ = the last negative Reaction in the set of $-x$ (summation index calculates first to last values)

$+c_1$ = the first positive Comment in the set of $+c$

$+c_n$ = the last positive Comment in the set of $+c$ (summation index calculates first to last values)

$-c_1$ = the first negative Comment in the set of $-c$

$-c_n$ = the last negative Comment in the set of $-c$ (summation index calculates first to last values)

f = the number of Fans or members of the Facebook group on that day

s = the number of Shares of the original post (the question) on that day

Step 5: Proceed if Results Pass the Provisions of the Theorem

It must be stressed that this research presupposes that both positive and negative engagement rates have a value greater than zero since division and multiplication by zero presents a totally new set of paradoxes altogether. To get the total positive and total negative engagement rates,

the individual engagement rate variables of Reactions, Comments, and Shares are added then divided by the number of Fans and Shares for the day, then multiplied by 100 to arrive at the percent value. The Index is obtained by dividing the total positive engagement by the total negative engagement.

Having both division and multiplication operations, the Equation and the Ratio therefore cannot have zero as a dividend, a divisor, or a multiplier. Such goes against the transitivity Theorem created specifically for this study, which states that—first and foremost—the final engagement rate should be “greater than zero” where:

$$(a \Rightarrow b) \Rightarrow [(b \Rightarrow c) \Rightarrow (a \Rightarrow c)] \text{ or } (a \Rightarrow b) \text{ and } (b \Rightarrow c) \text{ then } (a \Rightarrow c)$$

a = final engagement rate is greater than zero

b = sender, message, and receiver are present

c = communication is present

This is also why the Index cannot reach zero and, according to the Theorem above, no communication can be observed and represented by a number if the variables are equal to zero. The assumption is that communication has already started and is already present before it can be observed and measured.

This is also the reason why, on Day 1, the online U.P. Manila stakeholder-respondents (the project proponents) were requested to initiate the interaction by first Liking the Help Us Develop Facebook Community page (Liking is already a Reaction, which is one of the variables) so that there would already be an audience count (Fans) and an engagement (Reaction). In the first place, only Fans can see the posts on the Facebook page, so that was a requisite. Thus, if only one of the respondents performed this action, the dividend in the Equation would already have a value of at least “1” (one Reaction) and a divisor of at least “1” (one Fan).

Only after then was feedback made possible from the field at the Aeta resettlement area—they needed something on which to react aside from the “agriculture-or-education” question with the photo of a farmer.

The calculation for the final positive and negative engagement rates for the IKSP Aeta resettlement project pilot test was made for the entire set of stakeholders without disaggregating results between the beneficiaries and the project proponents. Yet such an operation can also be done if the disaggregation is needed. Such an operation would identify which individual stakeholders from the two groups voted for agriculture and which of them voted for education.

This study's Methodology and the formula for the Equation make it possible to disaggregate not only positive and negative engagement but also results from individuals or groups of respondents, since each engagement rate from each respondent is first calculated separately, something Facebook's base equation cannot do. We can thus see if the beneficiaries share a common opinion or are divided between positive and negative, or if the same can be observed from the project proponents' group.

This study's design and methodology gives the Equation the ability to disaggregate data by (i) positive or negative engagement, (ii) stakeholder-respondent grouping (project proponent or beneficiary), (iii) individual respondent, (iv) gender, (v) educational attainment, (vi) online or offline participation, (vii) age, (viii) residence, (ix) verbal response, or (x) nonverbal response. More variables could be disaggregated depending on the depth of detail in the research design. This disaggregation is something Facebook's analytics cannot do.

These significant modifications to Facebook's original engagement rate formula—through the Equation—is one of this study's contributions since Facebook calculates engagement as a whole without disaggregating positive and negative engagement and without disaggregating demographics of individuals or groups of people. It gives the modified Equation more utility for future studies.

For the sake of discovery and to determine if there is incongruence of opinion within the online project proponent group from U.P. Manila or within the offline Aeta community project beneficiary group (and to answer this study's research subquestions), let us disaggregate data by the following:

(i) online stakeholder-respondents (who also happen to be the project proponents from U.P. Manila, who are of higher educational attainment, and who are educators and students who may be perceived to be pro-education) and

(ii) offline stakeholder-respondents (who also happen to be the project beneficiaries from the Aeta resettlement area in Zambales, who are of lower educational attainment, and who are farmers who may be perceived to be pro-agriculture).

Table 11. Five-Day Data Disaggregated by Stakeholder-Respondent Type

Stakeholder Type	Positive Engagement	Negative Engagement	Ratio	Index
Proponents	115.985	113.382	29 : 28	1.022
Beneficiaries	115.350	138.157	23 : 28	0.834

SOURCE: Author.

Positive engagement with the discussion topic equates to agreement that agriculture deserves a bigger development budget than education, and negative engagement equates to agreement that education should get the bigger budget.

The data in Table 11 show that as far as the online, more educated, Manila-based project proponents are concerned, there is an almost even split of opinion (meaning not everyone was pro-education despite the fact that they were all either educators or students). The Ratio is "29 : 28," not far from the equal or "ideal" balance of "1 : 1" engagement. The Index is "1.022," also close to the base minority-majority engagement of "1."

Disaggregated results from the Aeta project beneficiaries, however, show a different picture. The Aetas of Loob-Bunga are subsistence farmers who rely heavily on agricultural produce planted in the mountains. However, the disaggregated tally shows that more beneficiaries believe they need more development projects in education rather than agriculture. The Ratio for the Aeta beneficiary group is "23 : 28" while the Index dipped below the base number "1" (0.834) which means those who favored agriculture among the Aetas were relegated to the minority. More engagement was recorded for education having a bigger budget for development projects.

This shows that, despite perceived homogeneity or group affiliation, opinion incongruence can occur within groups instead of between perceived demographic groupings or perceived biases. It also implies the existence of “hardcore” or “avant-garde” participants who behaved contrary to expectations.

This study’s findings about “within-forum” dissent are consistent with those of Hopkins (1999) and Meyer and Speakman (2016) who discovered in their respective research that members of the same group may themselves end up silencing an individual’s opinion expression—as opposed to media, the general public, or society as a whole silencing the minority. Meyer and Speakman discovered in their study of news forums that the Spiral of Silence persists even in closed groups or forums. Note that the discussion forum used in this study was a Facebook Community Page where the stakeholder-respondents are they themselves the Fans who joined the page by invitation.

Other forms of disaggregation can be performed with the data gathered. However, we are trying to determine if a Spiral of Silence occurred from Day 1 to Day 5 of interaction among the IKSP stakeholder-respondents from U.P. Manila (online) and the Aeta beneficiaries (offline), regardless of demographic groupings or affiliations (proponent/beneficiary, online/offline, educated/less-educated, male/female, etc.). We are attempting to quantify opinion incongruence, interaction, and engagement with a certain discussion topic, although this study’s Methodology can also measure incongruence between or within demographic groupings.

If such a spiral indeed manifested itself in the pilot test involving the IKSP project stakeholder-respondents, we are attempting to quantify that spiral by measuring its size and shape relative to time. And so we arrive at the final Ratios and Indexes from Days 1 to 5, shown in Table 12.

Table 12. Final Daily Ratio and Index

DAY	Ratio	Index
1	6 : 5	1.193
2	3 : 4	0.750
3	24 : 23	1.010
4	5 : 6	0.738
5	3 : 26	0.111

SOURCE: Author.

For the Index, neutral engagement or equal share of positive and negative is signified by the base value "1." The higher the Index is beyond "1," the more dominant is the majority. The lower the Index is below "1" and the more it approaches "0," the more acute and tapered is the spiral, yet the Index will never reach zero, as the variables must be greater than zero in the first place if we are to follow this study's Theorem that shows the presence of communication through numbers.

In terms of the Ratio, the equal or base engagement rate is "1 : 1". Engagement figures that are more than the other indicate a more dominant opinion, displaying the existence of a majority and a minority. Ratios were rounded off to the nearest whole number where needed.

Table 12 shows how the discussion favored one proposition over the other, with agriculture (positive engagement) taking a slight lead on Day 1 before dipping below "1" on Day 2. There was a positive resurgence, however, in agriculture engagement on Day 3 before declining again. By Day 4, positive Reactions and Comments in favor of agriculture waned, and the discussion began to heavily favor education. Even those who originally chose agriculture began to show negative engagement (in favor of education), showing a shift in opinion. By Day 5, the agriculture group had been pushed closer toward zero, showing that a Spiral of Silence had occurred in favor of education getting a bigger development budget and to the detriment of those who favored agriculture. Although the spiral did not reach zero which is not mathematically possible based on this study's

Theorem, it could have plummeted more (without reaching zero) if the study were conducted longer.

Note however, the fluctuation of the Index over the course of five days. On the first day agriculture was ahead, dipped on the second day, resurged on the third day, waned again on the fourth day, then sunk lower on the fifth and final day of the study. This indicates that, unlike Noelle-Neumann's spiral that is steadily declining from a wide funnel on top then consistently narrowing downward, some conversations and differences or incongruence in opinion may fluctuate until a majority opinion takes shape and takes hold.

Such is the dynamism of communication. Phenomena may not necessarily occur at a steady rate, or phenomena might not manifest itself at all (e.g., data returning a constant equal or base value of "1" for the Index and "1 : 1" for the Ratio). In which case a Spiral of Silence would not be recorded, and instead of seeing a conical shape tapering downward, we would see a perfect cylinder with a helix spiraling equally along its sides (with a constant base value of "1").

At this point, we are satisfied that the data—having been run through the Equation without encountering the zero conundrum and having arrived at the final Ratio and Index numbers—passes the transitivity Theorem for numerical representation of communication. We can now proceed to Step 6.

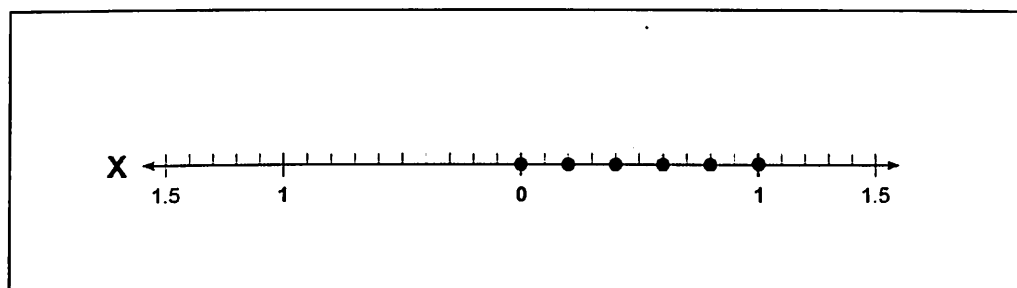
Step 6: Model and Construct the Spiral in 3D

With the required data at hand, how can we now "see" the spiral? How do we use the gathered data to construct a 3D model of a spiral, a cone, or even a cylinder? We use the Index derived from the Ratio to visualize the Spiral of Silence and apply those numbers to Euclid's axioms and postulates on geometry and space, specifically the propositions detailed in the previous chapter.

Before we use the actual data from the IKSP pilot test, however, let us plot a spiral the way Noelle-Neumann envisioned it—as having a wide funnel on top representing willingness to speak out depending on the prevailing opinion, and then steadily spiraling down the conical shape to the narrowest part at the bottom, which is fear of isolation.

On the x-axis, Noelle-Neumann's cone would be plotted as dots equally distant from each other, as shown in Figure 1, in accordance with Euclid's first postulate.

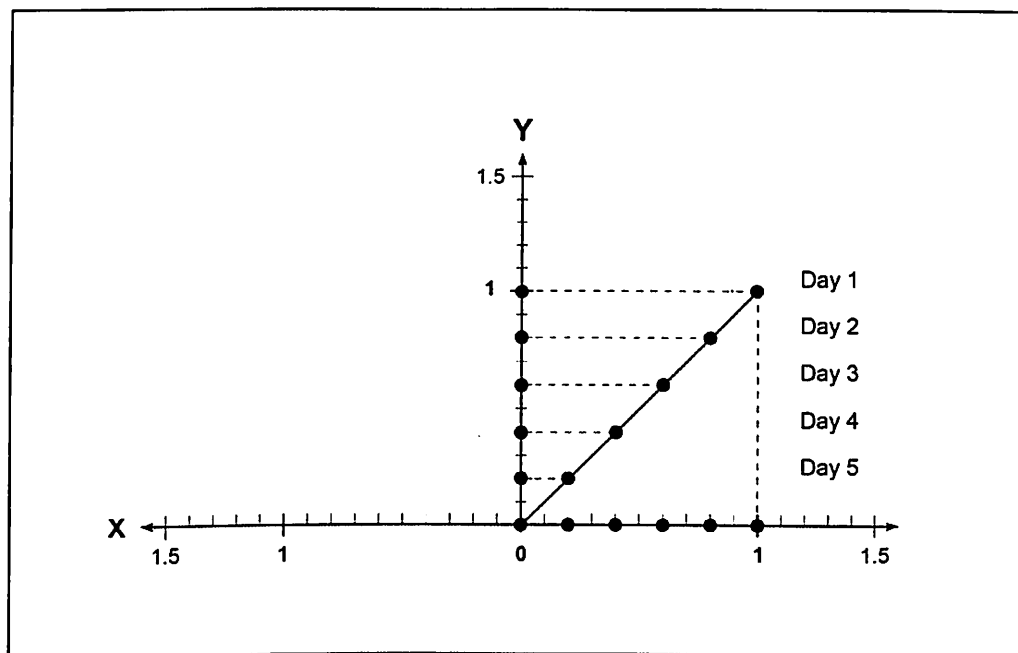
Figure 1. Noelle-Neumann's Perfect Conical Spiral on Euclid's R^1



SOURCE: Author.

The variable of time can then be plotted on the y-axis to represent the steady spiraling of Noelle-Neumann's spiral down the cone. The result is a two-dimensional plane connecting the points from R^1 which now becomes R^2 or Euclid's space of dimension two (Benson, 1966). The figures would now be plotted as ordered pairs (x and y) or coordinates on a two-dimensional plane, with the coordinates "0, 0" being the point of origin or the center. Now having coordinates, Euclidean space becomes Cartesian space (Benson, 1966) while still following Euclid's axioms and postulates.

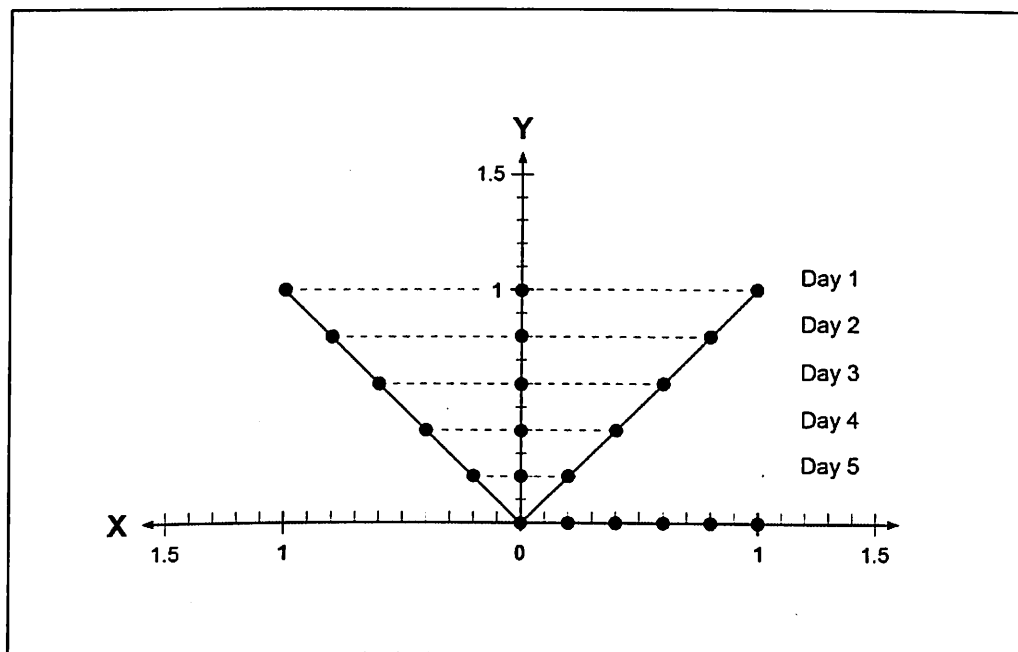
Figure 2. Noelle-Neumann's Perfect Conical Spiral on Euclid's R^2



SOURCE: Author.

Note that in Figure 2, in reality and following the methodology made specifically for this study while abiding by Euclid's two-dimensional coordinates on R^2 , the y-axis should start with Day 1 at the bottom and Day 5 on top. This is because all values on the x and y axes numerically increase from the point of origin (0, 0) progressively moving to 1, then 2, then 3, and so on and so forth. If we were to do that, however, Noelle-Neumann's spiral would become inverted—resulting in an upside-down cone. In keeping with Noelle-Neumann's original spiral design, in this example we will create a spiral with the wide mouth of the funnel on top (willingness to speak out) then tapering toward the bottom (fear of isolation).

Figure 3. Noelle-Neumann's Perfect Conical Spiral on Euclid's R^2 with Mirror Image

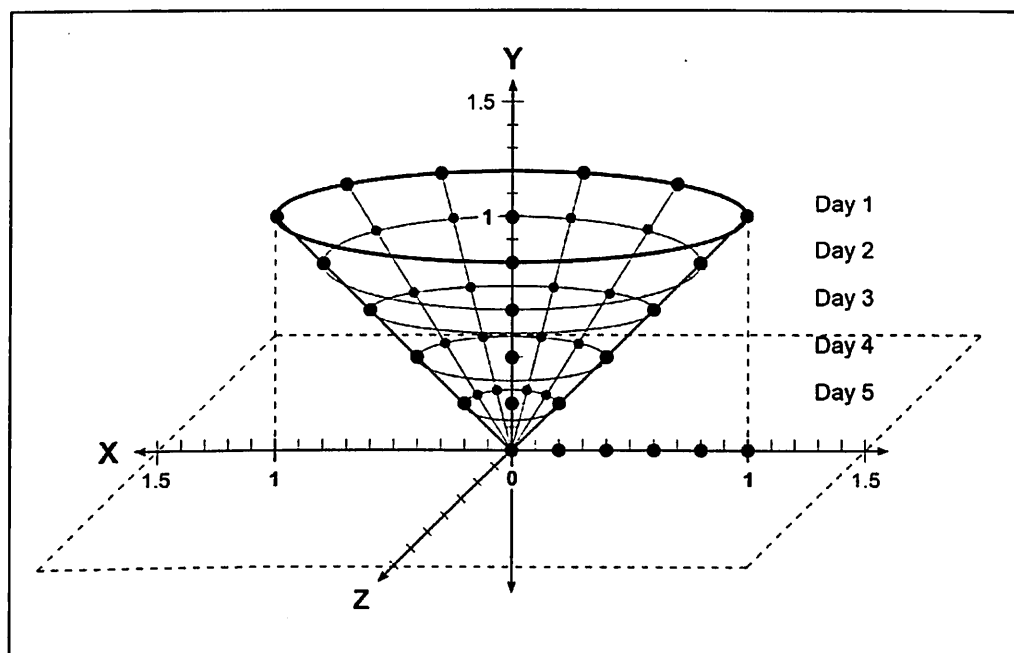


SOURCE: Author.

At this point and as shown in Figure 3, the resulting line on R^2 can represent all sides of the cone, and by projecting a mirror image of it we would begin to see the sides of the "funnel" created. This is because each point plotted on R^2 is equidistant from the point of origin $(0, 0)$ when mirrored across the plane—in accordance with Euclid's first axiom.

The third Euclidean space is three-dimensional and is denoted by R^3 . We can now add the z-axis to the x and y axes and a third coordinate to the previous two coordinates so that each point would now be in R^3 or 3D space. The point of origin now has three coordinates $(0, 0, 0)$ on what would now be Cartesian space. And since all points from R^1 and R^2 are equidistant from the origin when mirrored across a plane, they would also be equidistant from the origin when mirrored 360 degrees around Euclid's three-dimensional space. We can mirror the points and the lines 360 degrees around a circle as long as the points and coordinates $(x, y, \text{ and } z)$ and their accompanying lines and line segments are of equal distance from the point of origin $(0, 0, 0)$. This is in accordance with Euclid's third postulate and as shown in Figure 4.

Figure 4. Noelle-Neumann's Perfect Conical Spiral on Euclid's R^3 Mirrored 360 Degrees

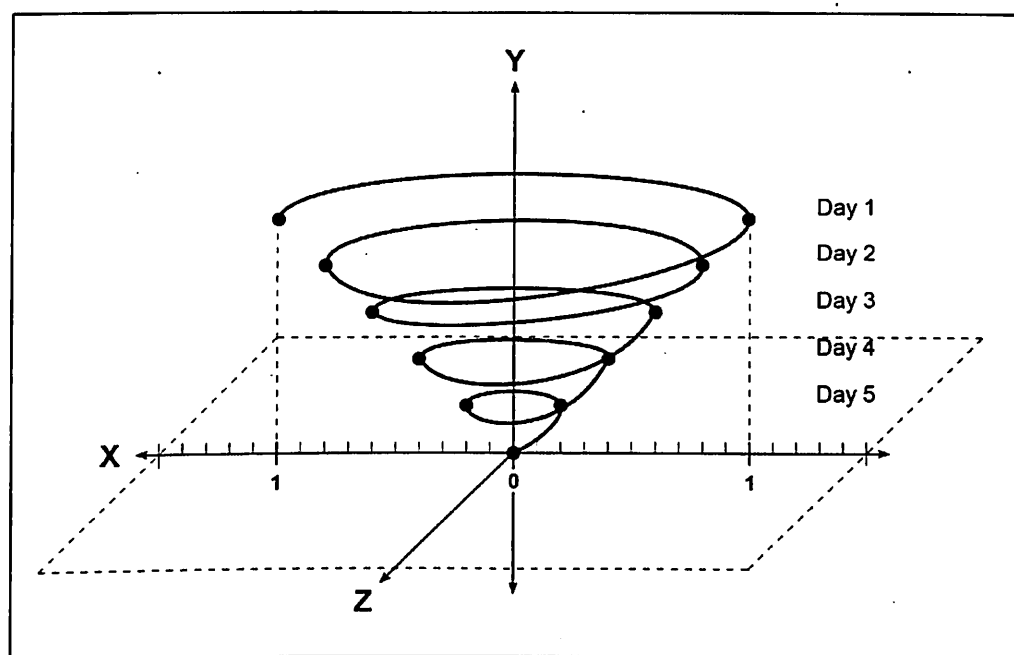


SOURCE: Author.

Now we can see a 360-degree wireframe outline of the perfect cone from Noelle-Neumann's model on Euclid's third dimension. The assumption here is that discussion participants were willing to speak out on Day 1 (mouth of the funnel on top) and then by Day 5 they had been inexorably drawn down the spiral (fear of isolation).

If we were to remove the wireframe guidelines and place a spiral within that cone, it would look thus:

Figure 5. Noelle-Neumann's Perfect Spiral

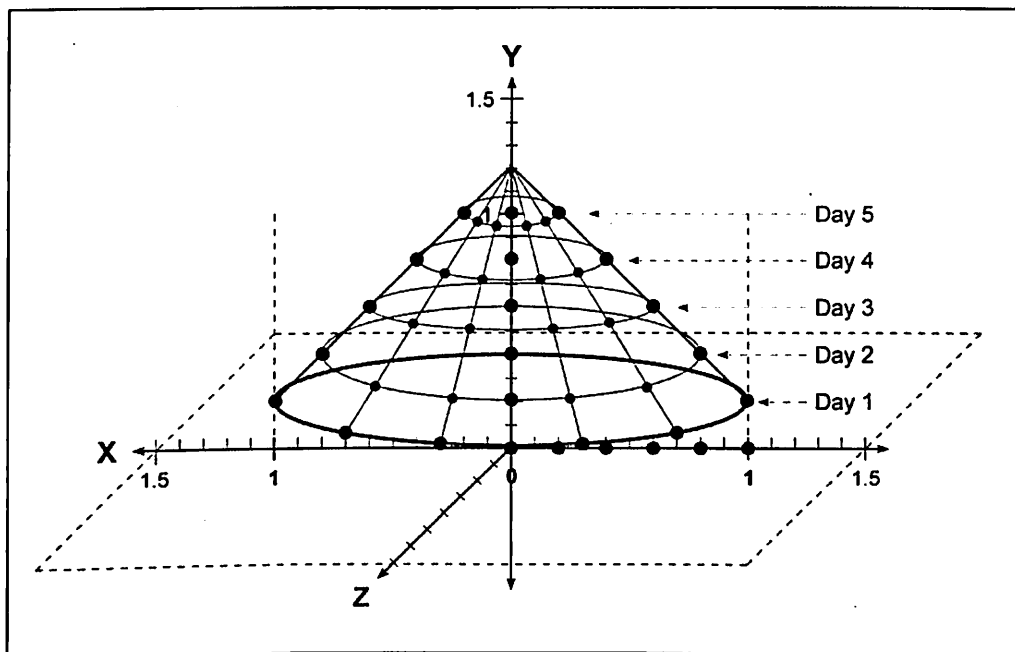


SOURCE: Author.

Now we can see the perfect spiral from Noelle-Neumann's model from a perfect cone where the top of the open funnel represents participants' willingness to speak out and the bottom of the spiral represents participants' fear of isolation. In Noelle-Neumann's perfect spiral, discussions wane constantly downward as less and less people participate in the discussions and fall down the Spiral of Silence. This is due to the discussants' assessment of the opinion climate. The more incongruent their opinion is from the perceived majority, the less they are willing to speak. Notice that the spiral reaches the point of origin (0, 0, 0). However, such a spiral would only occur if we were modeling it from Noelle-Neumann's original concept and diagram of a perfect conical spiral. If we were to follow the methodology made specifically for this study and abide by Euclid's two-dimensional grid coordinates on R^2 , the y-axis should start with Day 1 at the bottom and Day 5 on top.

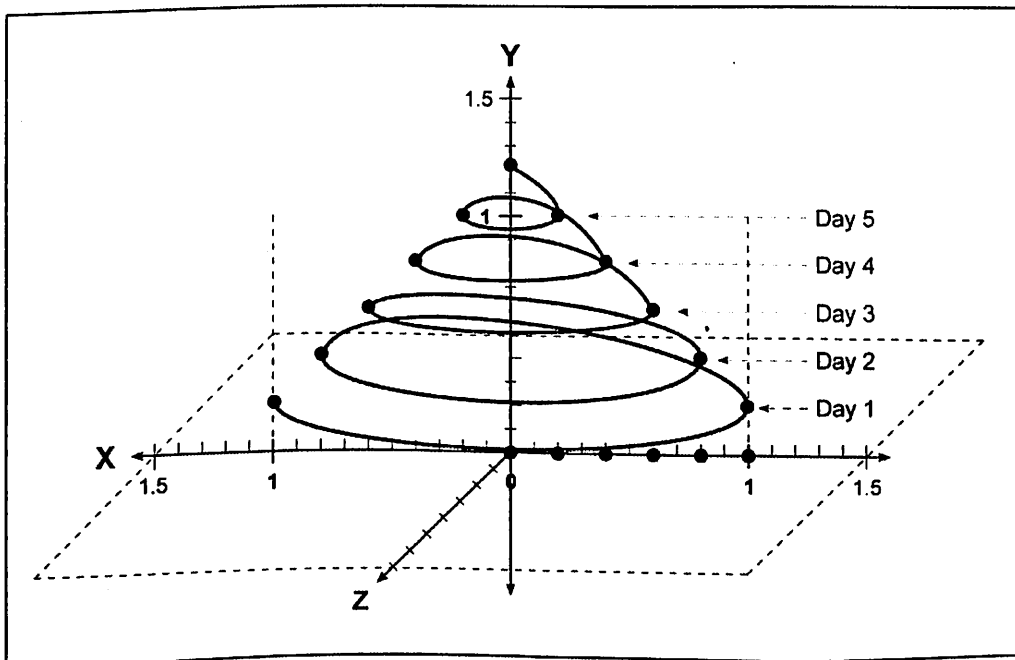
If we plot the values on the x and y axes while numerically ascending from the point of origin (0, 0) progressively moving from 1 to 2 to 3 and so on and so forth, we would instead see an inverted cone and an inverted spiral. Willingness to speak out (the wide mouth of the funnel) would be at the bottom while fear of isolation (the tapered point of the funnel) would be on top, as shown in Figures 6 and 7.

Figure 6. Noelle-Neumann's Wireframe Cone Shown Upside-Down



SOURCE: Author.

Figure 7. Noelle-Neumann's Spiral Shown Upside-Down

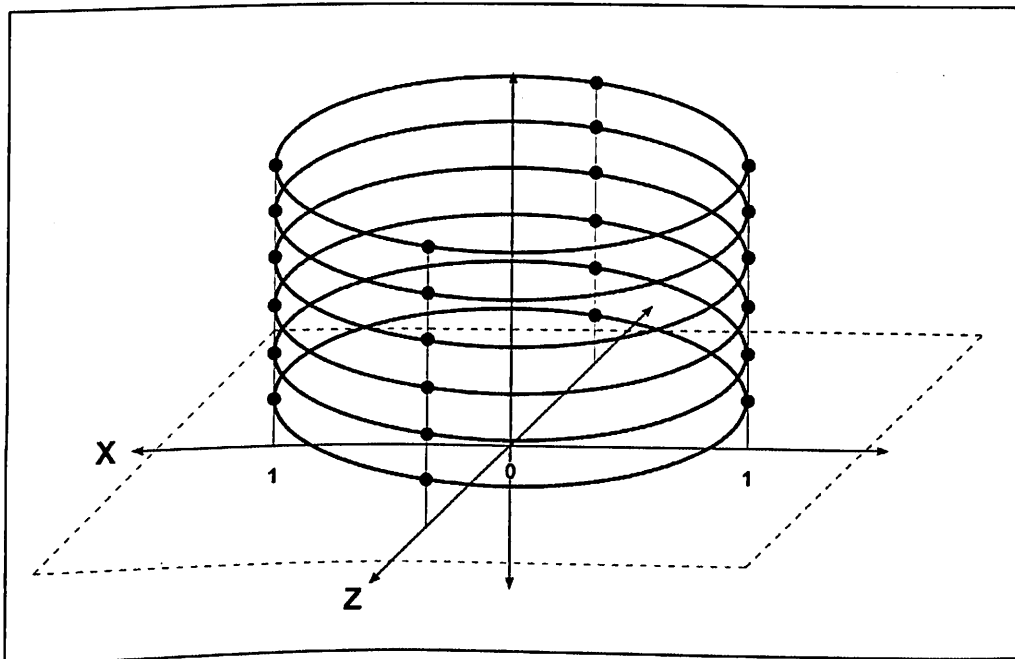


SOURCE: Author.

Another possibility is that discussions may start from a muted voice already in the Spiral of Silence then slowly finds its way in the majority as the opinion climate favors their opinion. In which case the spiral and the cone would be right-side up as shown in Noelle-Neumann's original diagram.

Yet, conversations do not necessarily degrade or improve at a constant rate and over time. Discussions can stay constantly equal among discussants (resulting in a stalemate), and it is possible that neither a minority nor a majority opinion would surface. In such a case, none of the discussants would fall into a spiral, and what would appear is a constantly sized helix within a cylinder instead of a downward spiral within a cone, as shown in Figure 8.

Figure 8. 360-Degree Outline of Perfect Cylinder for Helix with Constantly Equal Engagement



SOURCE: Author.

In Figure 8, the Index does not approach zero. The cylinder hovers above and does not taper toward the point of origin $(0, 0, 0)$ and instead remains constantly at the value "1" (having the highest probability of equality in

terms of engagement, or a ratio of "1 : 1"). There is no majority. There is no minority. There is a stalemate.

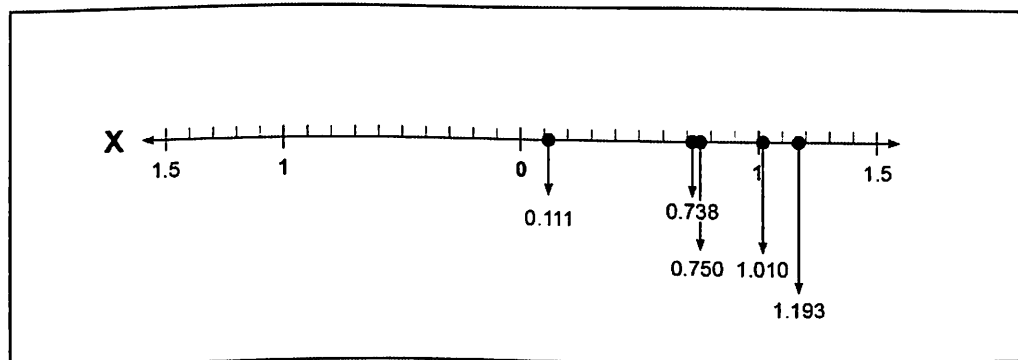
Yet another possibility is that, instead of remaining consistently equal at "1" or instead of constantly spiraling downward over a certain measure of time, discussions can wane, then surge, then wane once again depending on who has the majority voice or the proverbial microphone as the discussions progress.

In this study, the digital divide did not become a disadvantage for the Aetas as they were given the opportunity—the microphone—to correspond every day with their online counterparts whose numbers were the same (10 for both online and offline respondents). Without these equalizing factors, the Aetas would have, of course, fallen down the spiral by default due to lack of computer skills, equipment, and Internet connection. They would not have been able to participate in the discussion at all, and so the conversation would have become non-inclusive and non-participatory (Finsterbusch and Van Wicklin, 1987).

This study's time variable and hybrid online-offline discussion environment show that, given the opportunity to interact, discussants' engagement rates can fluctuate over time as a majority opinion begins to emerge.

Using actual research data, we first plot the Index numbers from the Help Us Develop Facebook Community Page on the one-dimensional x-axis of the R^1 real line, as shown in Figure 9.

Figure 9. Actual Research Data on Euclid's R^1



SOURCE: Author.

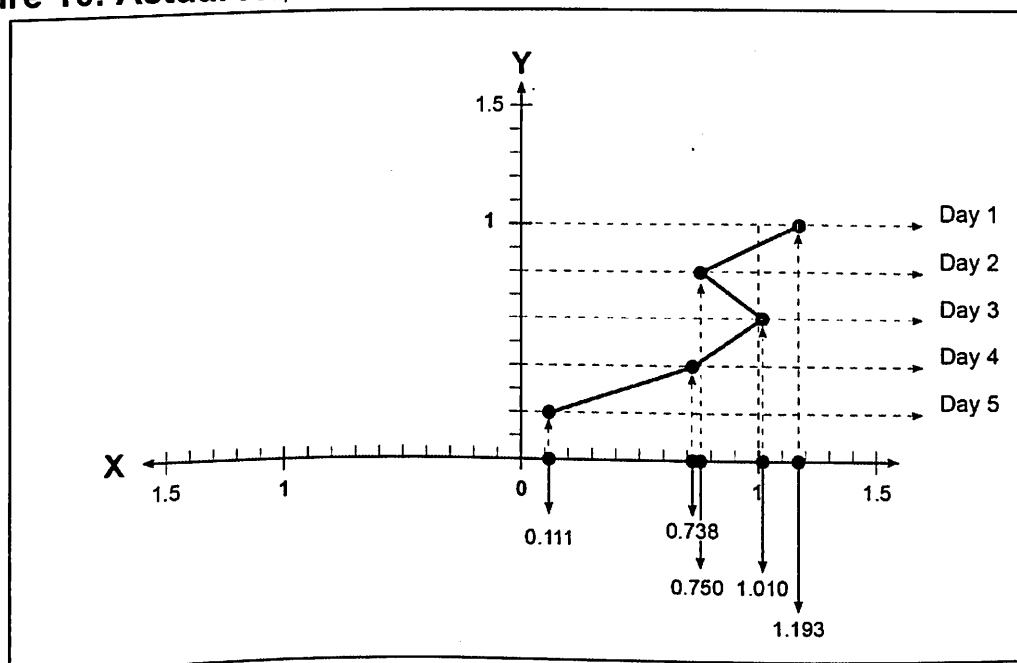
We then factor in the time variable and place that data on the y-axis on Euclid's R^2 or two-dimensional plane as if they were ordered pairs (x and y) or coordinates ([Day 1, 1.193]; [Day 2, 0.750]; [Day 3, 1.010]; [Day 4, 0.738], and [Day 5, 0.111]).

Again it must be stressed that, following the methodology made specifically for this study and Euclid's two-dimensional axes on R^2 , the y-axis should start with Day 1 at the bottom and Day 5 on top, as all values on the x and y axes increase from the point of origin (0, 0) moving up to 1, then 2, then 3, and so on and so forth. Yet doing so would create an upside-down spiral inside a cone with the open funnel at the bottom then tapering to the top, spiraling upward instead of downward.

And so, in keeping with Noelle-Neumann's original spiral design, in this example we will use the actual research data to first create an upright cone, a spiral with the funnel on top then tapering toward the bottom. Note that in reality the funnel would be inverted.

The data can now be plotted as coordinates on the two-dimensional plane, with the coordinates "0, 0" being the point of origin, as shown in Figure 10.

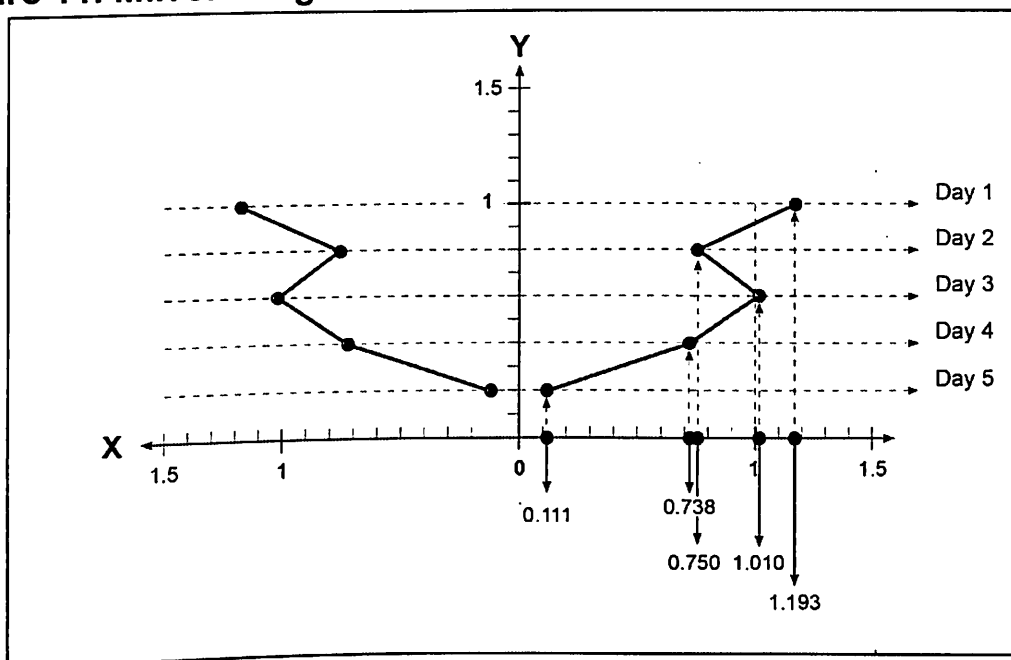
Figure 10. Actual Research Data on Euclid's R^2



SOURCE: Author.

Similar to how we derived the perfect cone and spiral, the coordinates above—when projected across a two-dimensional plane—would be equidistant from the point of origin. Thus, the mirror images in Figure 11 would represent the sides of an irregularly shaped funnel created from actual research data.

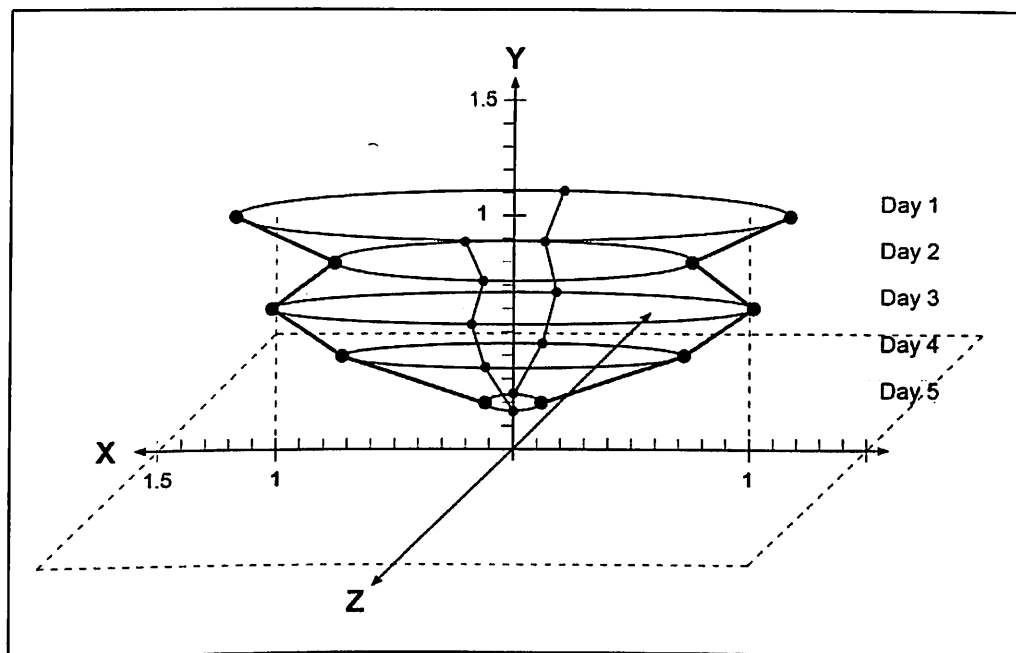
Figure 11. Mirror Image of Actual Research Data on Euclid's R^2



SOURCE: Author.

Finally, we add the z-axis to project the lines 360 degrees around a circle on R^3 space. And since all points from R^1 and R^2 are equidistant from the point of origin when mirrored across a plane, they would also be equidistant from the origin when mirrored 360 degrees around Euclid's three-dimensional space, which now has three coordinates (x, y, z), as shown in Figure 12.

Figure 12. Actual Research Data on Euclid's R^3



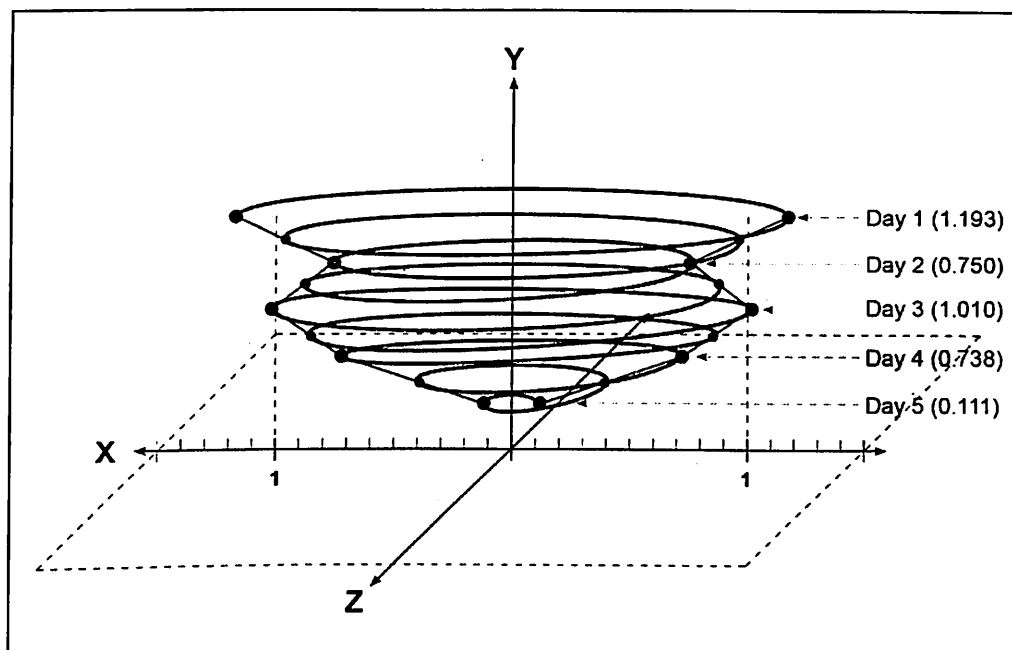
SOURCE: Author.

The result is an imperfect funnel and cone above that reflects the level of engagement which occurred from 25 to 29 November 2016 among online and offline stakeholder-respondents of the IKSP Aeta resettlement project.

Notice how the funnel hovers above and does not taper toward zero, the point of origin. Even if the y-axis reached Day 6, Day 7, or further, the zero conundrum would preclude the Index value from reaching zero because of indeterminate or undefined numbers which would result when zero is divided or multiplied. The Index could, however, reach extremely small values approaching zero.

If we add a spiral inside the image then delete the wireframe guidelines in the middle of the funnel, the spiral would look thus:

Figure 13. Imperfect Spiral with Funnel Outline Created from Actual Research Data

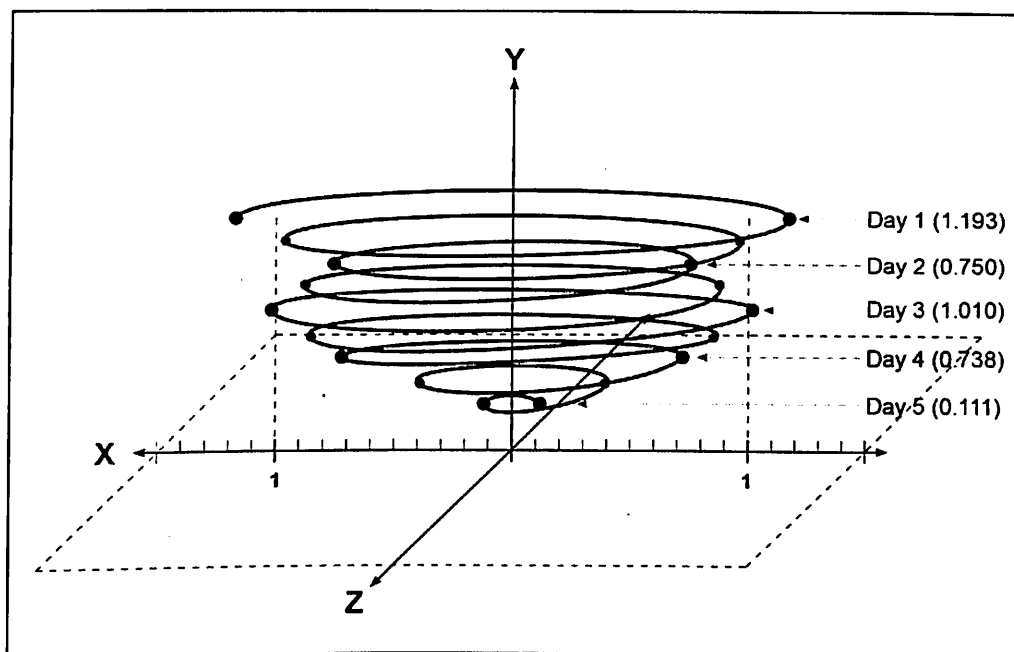


SOURCE: Author.

The remaining wireframe outline and dots on the sides of the funnel show where the x and y coordinates converge as engagement rates fluctuate over time. Note that the unit of measurement of time in this study is 24 hours (engagement data was collected every day, with cut-off time at midnight). Thus, every point on the x-axis corresponds with the Index for each day, and every point on the y-axis corresponds with each day of the study. We then added the z-axis and plotted the points with equal distance from the point of origin of the x and y coordinates. However, even though the unit of measurement of time is per day, we added sub-points in between the coordinates of each day to make the outline easier to see.

If we take away the wireframe outlines, points, and sub-points of the funnel, the bare and imperfect spiral—created from actual research data—would look thus:

Figure 14. Spiral of Silence Created from Actual Research Data



SOURCE: Author.

The spiral above shows communication occurring in an imperfectly shaped spiral flowing down through an imperfectly shaped funnel outlined from an imperfectly shaped cone. Such is how dynamic communication is. Sometimes discussions, engagement, and opinions fluctuate and favor one view over another and over time. Note how the bottom does not reach zero.

However, a spiral such as that shown in Figure 14 would only occur if we were modeling it from Noelle-Neumann's original conical spiral. Note again that if we strictly followed the ascension of values on the y-axis for the grid's time variable—with Day 1 at the bottom and Day 5 on top—the spiral would be inverted. Willingness to speak out or the open funnel at the top of the cone would be at the bottom, while fear of isolation or the tapered bottom of the cone would be on top.

If we were to follow the methodology made specifically for this study and abide by Euclid's two-dimensional coordinates on R^2 , and if we plot the values on the x and y axes while numerically increasing from the point of origin (0, 0) on the coordinate grid, we would instead see an inverted and imperfect cone spiraling and tapering upward, not downward, as shown in Figures 15 and 16.

The actual research data and the resulting spiral tell us that, on Day 1, the discussants favored agriculture as getting more development budget than education through a tally of positive engagement recorded.

Moving up (instead of down) to Day 2, pro-agriculture engagement dipped below "1," which is the base value or number of equal engagement, and pro-education viewpoints began to gain ground.

On Day 3, there was a positive resurgence of agriculture engagement which marginally overtook education.

By Day 4, positive Reactions and Comments in favor of agriculture waned yet again, and the discussion began to favor education anew.

By Day 5, the opinion of pro-education stakeholder-respondents had almost overwhelmed the agriculture group.

Positive engagement rates of those who favored agriculture as getting the bigger development budget had been pushed closer toward zero (but never reached it), showing that a Spiral of Silence had indeed materialized among opinions favoring agriculture.

However, it must be stressed that this research does not in any way claim that the IKSP project itself suffers from a Spiral of Silence in the course of project implementation. This study's question posed for discussion (the choice between development aid for agriculture or education) is not related to the project's objectives. The IKSP project merely served as a small-scale pilot test to gather substantial data to be fed into the Equation, especially because of the dichotomy in the composition of the project's stakeholder-respondents.

Chapter Ten

RESULTS, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This study features a refinement of existing analytical procedures—not just from social media metrics and indexes developed by Gini (1921); Withaar, et al. (2013); Effing, et al. (2011); Hall (2014); and Asur and Huberman (2010)—but primarily that of Facebook’s metrics to calculate post engagement. However, as explained earlier, one of this study’s significant contributions is the disaggregation of positive from negative engagement using data gathered from the field. It is by disaggregating such engagement then equating those values with minority and majority opinion data that the opinion gap was measured. That opinion gap then served as the basis to derive the Index, which in turn was used to measure then model in 3D the Spiral of Silence.

Disaggregation is a significant aspect of the term “engagement” because whereas online and social media marketers offer engagement as a whole to indicate the success of a communication campaign, such aggregated engagement values may in fact be composed of both positive and negative interactions. The Equation in this study and the resulting Ratio show us the true measure of incongruence between two opposing viewpoints. They also demonstrate that engagement as a whole does not always equate to hegemony or a common viewpoint—it could lead to a clearer picture of dissonance between viewpoints. Organizationally, such data could be used to study communication dynamics when two opposing sides are in dissonance, as opposed to Kincaid’s (1979) view that the ultimate goal of communication is mutual understanding.

The development project at the IKSP Aeta resettlement area served as a pilot test in which this research could be operationalized on a small scale. As earlier stated, the focus of this research was to pilot test the proposed measurement and modeling tools (the Equation, the Ratio, the Index, the Theorem, and the Methodology) using actual research data.

Based on calculations from the Equation using data from the Help Us Develop Facebook Community Page and the engagement rates gathered from the hybrid online-offline discussions of the stakeholder-respondents, let us go back to this study’s research questions and objectives to draw our conclusions.

Question: "What would be the size and shape of the Spiral of Silence when opinion gaps are measured and modeled using social media engagement rates?"

That opinion gap is the incongruence gap, or the proportion of positive engagement (agreement) in relation to negative engagement (disagreement) with the development aid discussion on the Facebook page. That discussion was sparked by a question—whether agriculture (positive engagement) or education (negative engagement) deserves the bigger development budget. The social media engagement formula used was the Equation. The resulting Ratio was then converted to an Index. We are looking for both the size and the shape of the spiral.

If we were to get the overall total positive engagement versus the total negative engagement for the five days of interaction, the numerical representation of the "opinion gap" being asked by the research question would be the Ratio and the Index, as shown earlier in Table 10. That is, over the course of five days, the opinion gap was "9 : 10" in favor of education getting the bigger budget over agriculture, or a downward spiral Index of ".900" for the proposition that agriculture should get the bigger budget (with "1" being the base number).

That was the overall size of the spiral produced in the pilot test over 5 days.

However, if we were to factor in the time variable of this study to show the rate of increase or decrease in engagement, we would get more meaningful numbers (the Indexes) from which we could model and see the shape of the spiral. With time factored into the y-axis, the answers to the research question would be:

(i) On Day 1, the opinion gap in terms of the Ratio was "6 : 5" and in terms of the Index it was "1.193."

(ii) On Day 2, the opinion gap in terms of the Ratio was "3 : 4" and in terms of the Index it was "0.750."

(iii) On Day 3, the opinion gap in terms of the Ratio was "24 : 23" and in terms of the Index it was "1.010."

(iv) On Day 4, the opinion gap in terms of the Ratio was "5 : 6" and in terms of the Index it was "0.738."

(v) On Day 5, the opinion gap in terms of the Ratio was "3 : 26" and in terms of the Index it was "0.111."

From this data, we determined the shape of the spiral. The 3D model of an upside-down and imperfect spiral shown in the previous chapter (Figure 16) is the shape of the resulting Spiral of Silence based on actual research data taken from the pilot test and strictly following the Methodology of this research.

The research question also has the following subquestions, listed below with their corresponding answers:

► How much total positive engagement was recorded?

Answer: 193.809

► How much total negative engagement was recorded?

Answer: 215.238

► How much positive engagement was recorded from project beneficiaries?

Answer: 115.350

► How much negative engagement was recorded from project beneficiaries?

Answer: 138.157

► How much positive engagement was recorded from project proponents?

Answer: 115.985

► How much negative engagement was recorded from project proponents?

Answer: 113.382

► Do the positive and negative engagement rates show a gap or incongruence in opinion?

Answer: Yes.

► Is the gap or incongruence in opinion unanimously split between the two groups or does it occur among and within them?

Answer: It is not unanimous, it is split. It occurs within and among both groups.

► Can that gap be quantified as a ratio (the Ratio)?

Answer: Yes, a Ratio of "9 : 10" (total for 5 days).

► Does the gap indicate a spiraling process?

Answer: Yes, downward.

► Can that gap be expressed as a mathematical index (the Index)?

Answer: Yes, an Index of "0.900" (total for 5 days).

► Can that index quantify the size and shape of the spiral?

Answer: Yes. The spiral size and shape fluctuated from "1.193" to "0.750" to "1.010" to "0.738" to "0.111."

► Beyond the development sector, can the Equation, the Ratio, and the Index be used together to measure other engagement dynamics such as demand-supply or receiver-sender communications?

Answer: Possible. See discussion below.

Using an Equation modified from the original Facebook engagement rate formula, this study has shown that social media metrics can indeed measure communication dynamics among discussants using positive and negative engagement as indicators. Since those indicators of agreement or disagreement with the development aid discussion topic also show minority-majority opinion incongruence or gaps, this study has demonstrated that the Ratio and the Index have the potential to become tools to quantify the size and model the shape of communication phenomena such as Spirals of Silence.

This study thus fulfills the primary objective of the research, which was "to quantify, visualize, and construct a 3D model of a Spiral of Silence based on actual research data gathered from a small-scale pilot test."

To achieve that objective, we needed to determine if the Ratio and the Index could be used as research tools to measure minority-majority dynamics and the Spiral of Silence using a hybrid online-offline environment.

This research has shown that yes, it is indeed possible to quantify, visualize, then construct a 3D model of a Spiral of Silence based on actual field data and that yes, the Index and the Ratio were indeed used successfully to measure minority-majority dynamics in the IKSP pilot test using development budget allocation as an online-offline discussion topic.

We have also fulfilled the secondary objectives of the study, which were to see if (i) the Spiral of Silence Theory would apply in development communication dynamics using social media discussions about development aid, (ii) thicken the discourse on the four-decade-old Spiral of Silence Theory in the context of social media, and (iii) offer the metrics and methodology developed in this study as research and measurement tools for future studies. Following are the discussions for those secondary objectives.

The research data show that the Spiral of Silence observed in the pilot test's Facebook discussion exercise can indeed be measured using social media engagement rates. This may indicate that the assumptions of the pre-Internet Spiral of Silence Theory applied not only to traditional media more than 40 years ago when the theory was created, but also today in the age of social media. However, since an erratic spiral was observed in the five-day study using engagement rates, those assumptions and the original model of the Spiral of Silence may need to be revisited.

Downward spirals coming from the top (from willingness to speak out due to the prevailing majority opinion) then tapering down to fear of isolation (resulting in silence)—as illustrated by Noelle-Neumann's "perfect" conical spiral—do not always occur at a steady, constant, or consistent rate. This research has shown through the "imperfect" spiral produced from the discussions between offline Aeta beneficiaries and online project proponents from U.P. Manila that, over time, minority-majority dynamics could shift and produce irregularly shaped or even upside-down spirals of silence. As demonstrated by (i) this study's Methodology, (ii) results from the Aeta project pilot test, and (iii) Euclid's x and y coordinate grids and ordered pairs on the two-dimensional R^2 plane, the Spiral of Silence does not always go downward as Noelle-Neumann originally envisioned.

The wide and open part of the funnel still represents willingness to speak out and the tapered end still represents fear of isolation, although the spiral could turn upside-down (tapering upward). Noelle-Neumann's original concept of an upright and perfect cone with a helix inside spiraling and tapering downward was not produced following this study's Methodology to visualize the size and the shape of the spiral. What was modeled instead was an imperfectly shaped upside-down cone with a helix spiraling and tapering up. Noelle-Neumann does, however, allude to such phenomenon by stating in Assumption 5 of the Spiral of Silence Theory that opinions can shift as the four other assumptions lead to a process of formation and as—over time—one opinion becomes established as the predominant one.

The upside-down spiral occurred because when the study was designed and conducted, we did not know which engagement or opinion would dominate—agriculture or education. The study design stipulates that positive engagement (agriculture or $+E$) would be divided by negative engagement (education or $-E$). Yet this research finds that, if $+E$ becomes the majority and “wins,” we would get an upright spiral. If $-E$ “wins” (which is what happened in this pilot test), we would get an upside-down spiral.

The 3D model could be reversed and become right-side-up if we divide the $-E$ results by positive $+E$. The spiral would still be imperfect but would flow and taper down the way Noelle-Neumann envisioned it (but then, it would not follow the methodology set earlier).

Alternatively but incorrectly (according to the stipulations of Euclidean and Cartesian 3D space), we could create an upright (right-side-up) spiral by plotting the figures downward from the point of origin (below zero), but that would lead us to the realm of negative numbers on the y-axis. Vertically, the spiral should not and could not possibly reach zero—it is against the stipulations of the Theorem. Not being able to reach zero, it could neither reach the quadrant of negative numbers.

Yet regardless of the upward or downward direction of the spiral modeled from the research results, such data on positive-negative engagement or minority-majority opinion incongruence would still be useful for many organizations wishing to feel the pulse of their audience.

Moreover, the hybrid online-offline Methodology of this study also shows that real-world interactions can serve as analogs of social media engagement and that online engagement rate calculations can be extracted from Facebook then concretized into an Equation that can be used offline in field surveys. These real-world analogs not only simulate certain features of social media; they also level the playing field among discussants and mitigate the disadvantages of the digital divide by allowing people in less-developed areas with less-educated and less-skilled people to participate in the discussion.

This opens up opportunities for bottom-up communication and opinion gathering, for example, in development projects where certain stakeholders neither have the skills nor the access to engage in online communication.

And since the Methodology works for a hybrid online-offline study, a purely online methodology conducted entirely on Facebook would work as well. Future studies could look more closely into such a methodology.

Interestingly and as shown by this study, opinions do not necessarily occur homogeneously—that is, coming from the same demographic affiliations or perceived sociological or socioeconomic aggrupation. Whereas this study clearly separated stakeholder-respondents into (i) project proponents (who also happened to be online in developed areas, more educated, and are either educators or students expected to vote for education) and (ii) project beneficiaries (who also happened to be offline in less-developed areas, are less-educated, and are all farmers expected to vote for agriculture), the results show that even within these groups and across demographics, dissent and opinion gaps emerged.

This shows that opinion incongruence can occur within known group affiliations instead of between perceived demographic groupings or perceived biases and inclinations. It also implies the existence of “hardcore” or “avant-garde” participants who behaved contrary to expectations in the IKSP pilot test.

The within-group and between-group opinion incongruence among the project beneficiaries and the project proponents validate Noelle-Neumann’s (1974) prediction of the occurrence of “spirals within groups” and “spirals between groups.” Findings from the IKSP pilot test are similar to those of the study by Jeffres, et al. (1999) on the criminal trial of O.J. Simpson, which found that opinion incongruence can happen both within and between two clearly identified respondent groups—the perceived minority (African-Americans) and the perceived majority (Caucasian Americans). This is the reason why a clear identification of two groups (beneficiaries and proponents) was designed in the pilot test.

This study looks at development project communication from the minority lens. However, results of the IKSP pilot test show that minority-majority opinion dissonance could occur within or between (or both) the beneficiary and proponent groups, with the less-educated beneficiary group of farmers being the perceived marginalized minority. Moreover, engagement from the perceived minority (the beneficiary group of farmers) with regard to education getting the bigger development aid budget even surpassed that of the proponent group (who were perceived to be pro-education, being educators and students).

It was explained at the start of this study that the term “minority” does not in any way refer to people differentiated from the social majority through ethnic or socioeconomic circumstances. The term refers to the minority opinion resulting from the hybrid online-offline discussion on Facebook. This study shows that the minority in a discussion is composed of

participants whose views are marginalized by a bigger number of engagement from discussants comprising an opposing view (the majority). In this study, being in the minority is not a factor of the number of members within a group as both project proponents and project beneficiaries had an equal number of members (10 each). For the pilot test, this study finds that assigning the status of minority or majority to any group of any composition is a matter of determining the stakeholder-respondents' opinions as to which sector—agriculture or education—would get the bigger engagement measurement from all participants. Being part of the minority or the majority is thus a matter of respondent engagement and opinion, regardless of demographics.

On the subject of muted voices, the minority lens, bottom-up communication, and the possibility that project beneficiaries could be more susceptible to falling into the Spiral of Silence than the project proponents, the data show that such is actually the reverse, at least as far as the pilot test results show. The final tally indicates that negative engagement (pro-education responses) edged out positive engagement (pro-agriculture responses). This means that majority of the engagement was for education while engagement for agriculture was in the minority. However, the disaggregated results show that the Aeta beneficiaries—who were subsistence farmers—registered more engagement in favor of education (138.157) than the project proponents (113.382). This means there was more Aeta beneficiary engagement favoring education than there was from the project proponents. The Aeta beneficiaries who chose education (beneficiary opinion was not unanimous) were not silenced. They were actually the most vocal and in the majority. At least for the IKSP test pilot, the pro-education Aeta beneficiary voice was not muted. They did not fall into the spiral (although the pro-agriculture Aeta beneficiary voice did).

This again demonstrates that—as far as this study is concerned—being part of the minority or the majority is a matter of respondent opinion regardless of demographics or perceived biases and inclinations. It is also possible that the hybrid online-offline environment employed by this research gave the Aeta beneficiaries a chance to voice out their opinion—they were not silenced by default. This may indicate that, given the opportunity to participate in the discussion by employing bottom-up communication and providing a level playing field for communication, the opinion of development project beneficiaries does not necessarily have to be polarized and marginalized.

On the subject of quantifying communication, this research shows that—using the transitivity Theorem—numerical values can represent the presence or absence of communication. Through the Equation, the Ratio, and the Index, opinion gaps and minority-majority interplay were measured by numbers, as long as the communication process is not completely bereft of the requisite components of sender, message, and receiver (i.e., as long as the starting and end points are not “zero” or the state of complete absence of communication).

The Equation, the Ratio, the Index, the Theorem, and the Methodology are thus contributions of this study that proved to be useful in measuring communication among the participants or the members of the IKSP project. It must be stressed that this study did not specifically test the likelihood or severity of opinion incongruence occurring within the IKSP as a project. Nor does it imply that the IKSP as a project contains muted voices or that the proponents are not listening to the beneficiaries (development of agriculture and education are not objectives of the IKSP project). What was being tested—and this point needs to be emphasized—were the utility of the Equation, the Ratio, the Index, the Theorem, and the Methodology.

As communication measurement tools, the Equation, the Ratio, and the Index may be able to quantify the opinion incongruence or the engagement gap between the minority and the majority opinion, quantify the size, then model the shape of the Spiral of Silence produced, if any. They could assist researchers measure bottom-up communication in the development sector and determine areas lacking in development assistance or other forms of service as identified by the stakeholder-respondents themselves.

The Equation, the Ratio, and the Index could also assist organizations determine how well or how poorly they are listening to their stakeholders. They could help development aid donors and project proponents see if they are overperforming or underperforming from the viewpoint of the beneficiaries. The Equation could also quantify relationships and dynamics between message/service receiver and sender in general (the formula can be modified and applied to other sectors in future studies by other researchers).

This study and the use of the Equation, the Ratio, and the Index cut across many applications. It can be used for communication research that seek to quantify discussion participation in a topic, determine what the audience wants or needs, and monitor stakeholder engagement for the purpose of

using that data to perform corrective or preventive measures and avoid falling into the spiral.

Future studies could look into refining and expanding the time variable of this study so that organizations could make projections and take proper action long before any such downward spirals occur.

The Equation, the Ratio, and the Index could also be used as tools not just for development but also for quantifying communication dynamics in marketing, advertising, media, public governance, public relations, and the service industries in developing and less-developed areas. They can be used for other communications phenomena not limited to the development agenda and debate about development aid. Future studies could look into further modifying the Equation for various feedback purposes and for quantifying minority-majority (or positive-negative) engagement dynamics from sectors not limited to development work.

For example:

(i) For politics and governance, it may lead to requests from constituents that have been unheard by national leaders simply because the citizens and civil society do not have a venue to air their concerns. Here, a modified Equation can be used to see if government can still feel the pulse of the people, and whether or not the current administration is serving the citizenry adequately in terms of priority focus and geography.

(ii) For marketing and product development, the Equation could be used to determine a company's lack of attention or excess attention given to certain consumer demographics since the consumers themselves can now give them their own "wish list," leading to possible development of new product types and cornering market niches that were previously unrealized.

(iii) For mass media organizations, the Equation may lead to new online content strategies, broadcast programming, and publication planning based on what kind of content hyperlocal communities want to consume in the news and entertainment media.

(iv) For the research industry, the Equation can provide new statistical data that have traditionally been unnoticed, leading to insights from the populace that were previously undocumented and unquantified.

(v) For the service industry, a modified Equation can cut down on costly operating expenses to discover underserved service areas where an organization lacks customer support.

(vi) For organizational communication, a modified Equation can lead to better staff feedback, workforce analysis, and human resource knowledge, as long as the Facebook page is created as a “secret group” accessible only by staff members or by using Facebook Workplace (a private, corporate version of Facebook run locally through corporate intranets).

The creation of this study’s metrics thus allowed us to quantify and visualize—or measure and model—the Spiral of Silence based on a small-scale pilot test of the Equation, the Ratio, the Index, the Theorem, and the Methodology using a hybrid online-offline Facebook forum. This also enabled us to further discuss Noelle-Neumann’s four-decade-old theory and see its applications in social media and modern development communication.

In conclusion, this study’s primary objective—to quantify and construct a 3D model of a Spiral of Silence based on actual research data—was fulfilled. The secondary objectives—applying the Spiral of Silence to social media in the context of development communication and thickening the discourse on the theory in the context of modern communications—have also been fulfilled.

Moving forward, this study proposes a future research agenda to (i) further validate this small-scale pilot test by expanding the scope of research to bigger projects using a bigger set of respondents, (ii) refine the quantification of the Spiral of Silence using the Equation, the Ratio, and the Index, (iii) refine the time-based variable in this research in future attempts to measure the dynamic movement of the spiral (to enable organizations to make long-term projections), (iv) refine the 3D visualization and modeling aspect of the study to construct more accurate models of Spirals of Silence, (v) further modify the already modified Equation to capture respondent feedback in the offline real world without actually using Facebook, (vi) explore how various organizations could use social media engagement rates to reinvent the way they gather and analyze minority-majority data and opinion incongruence, and (vii) further revisit the aging Spiral of Silence Theory in the social media age where engagement is used as a metric of agreement or disagreement and opinion incongruence.

ADHERENCE TO ETHICAL GUIDELINES

This study adheres to the American Psychological Association's Ethical Principles and Code of Conduct, Standard 8: Research and Publication, with focus on the following:

8.02: Informed consent—"inform participants about (1) purpose of research; (2) right to decline or withdraw; (3) foreseeable consequences of declining or withdrawing; (4) factors that may be expected to influence their willingness to participate such as potential risks, discomfort, or adverse effects; (5) any prospective research benefits; (6) limits of confidentiality; (7) incentives for participation; and (8) whom to contact for questions about the research and participants' rights."

The researcher briefed the U.P. Manila respondents in person on 21 November 2016. The next day, the U.P. professors and students (the project proponents) informed the Aeta community in Zambales about the researcher's arrival (via cellular phone and through the LGU). The U.P. Manila students and professors also visited the site—as part of the regular administration of their project—a day before data gathering commenced, and the Zambales respondents were briefed once more, this time in person.

Upon arrival at the Aeta resettlement area, the researcher briefed the Aeta beneficiaries in person. In both briefings, respondents were made aware that the exercise was part of an ongoing dissertation research.

It was stressed that the survey was purely voluntary. Respondents were not forced to contribute on a daily basis (in fact, some of them did not do so). Moreover, the respondents did not object to having their names and demographics listed in a table.

The Help Us Develop Facebook Community Page and the question posted therein were shown to both Manila-based and Zambales-based respondents prior to the survey. The Community Page itself carries the following disclaimer:

"This page allows you to state which sector you think needs development assistance. This page is part of an ongoing study on communication."

8.03: Informed Consent for Recording Voices and Images in Research—Photos and short video clips of the Zambales respondents

were taken during fieldwork for documentary purposes. Permission from the subjects was secured prior to filming or photography.

Two subjects who did not agree to be photographed simply went out of the camera frame. Only two photographs which included some of the willing subjects were used for this study. The other photos and video footage were for the researcher's personal storage as souvenirs.

8.06: Offering Inducements for Research Participation—No inappropriate financial or other inducements for research participation was involved in this study. Having been part of the IKSP program for years, the project beneficiaries were used to being asked questions. Meanwhile, the project proponents from U.P. Manila were used to engaging in conversation on Facebook.

8.07: Deception in Research—There is no such element in this research. The research objectives were made clear to all respondents and the researcher properly introduced himself, as well as the nature and purpose of the study.

8.10: Reporting Research Results—All raw and processed data stemming from this research are in this dissertation. Handwritten notes may also be made available if needed. If significant errors are discovered in the published data, this researcher will take reasonable steps to correct such errors in a correction, retraction, erratum, or other appropriate publication means.

8.11: Plagiarism—The researcher declares that this work is entirely original and that proper attribution was observed throughout the creation of the manuscript.

The dissertation manuscript itself was run through iThenticate—a plagiarism detection software service—and returned 10% overall similarity with papers, publications, and other materials found on the Internet. Of the 10% total similarities, individual similarities were <1% which is a low figure for iThenticate.

Similarities were from bibliographical references; paraphrasing; direct quotations; the standard ADB disclaimer; and common terms, phrases, and jargon used in academic studies.

Image 7. Anti-Plagiarism Scan Results

15-Dec-2016 12:07PM 24092 words - 158 matches - 77 sources

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FACEBOOK MINORITY RATIO AND SPIRAL SEVERITY INDEX:
QUANTIFYING THE SPIRAL OF SILENCE IN
DEVELOPMENT COMMUNICATION

LEONARDO A. MAGNO JR.

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4	Internet	99 words crawled on 20-Apr-2012 www.mcgraw-hill.co.uk	<1%
5	Internet	99 words crawled on 19-Feb-2015 www.fenrong.net	<1%
6	Internet	98 words crawled on 17-Nov-2014 jbor.oxfordjournals.org	<1%
7	Internet	96 words crawled on 02-Aug-2016 en.wikipedia.org	<1%
8	Internet	91 words crawled on 10-Oct-2016 lucian.uchicago.edu	<1%
9	Crossref	86 words Schulz, A., and P. Roessler. "The Spiral of Silence and the Internet: Selection of Online Content and the Perceptio	<1%

Internet 79 words <1%

PAGE 1 OF 110 Test-Only Report

SOURCES: Author, iThenticate.

8.13: Duplicate Publication of Data—"Publishing, as original data, data that have been previously published." None of the contents of this manuscript has been published previously.

8.14: Sharing Research Data for Verification—After research results are published, this student will not withhold the data from other competent professionals who seek to verify the substantive claims through reanalysis and who intend to use such data only for that purpose, provided that the confidentiality of the participants can be protected and unless legal rights concerning proprietary data preclude their release. This researcher welcomes and solicits the creation of derivative work from this study, with the request that the methodology herein be replicated in larger, more comprehensive studies to validate the utility of the Equation, the Ratio, the Index, the Theorem, and the Methodology.

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