JDDM
Journal of Dynamic Decision Making

Open Access

Theoretical Contribution

The empirical potential of Live Streaming beyond cognitive psychology

Alexander Nicolai Wendt[1]

[1]Department of Psychology, Heidelberg University, Germany

Empirical methods of self-description, think aloud protocols and introspection have been extensively criticized or neglected in behaviorist and cognitivist psychology. Their methodological value has been fundamentally questioned since there apparently is no sufficient proof for their validity. However, the major arguments against self-description can be critically reviewed by theoretical psychology. This way, these methods' empirical value can be redeemed. Furthermore, self-descriptive methods can be updated by the use of contemporary media technology. In order to support the promising perspectives for future empirical research in the field of cognitive psychology, Live Streaming is proposed as a viable data source. Introducing this new paradigm, this paper presents some of the formal constituents and accessible contents of Live Streaming, and relates them to established forms of empirical research. By its structure and established usage, Live Streaming bears remarkable resemblances to the traditional methods of self-description, yet it also adds fruitful new features of use. On the basis of its qualities, the possible benefits that appear to be feasible in comparison with the traditional methods of self-description are elaborated, such as Live Streaming's ecological validity. Ultimately, controversial theoretical concepts, such as those in phenomenology and cultural-historical psychology, are adopted to sketch further potential benefits of the utility of Live Streaming in current psychology debates.

Keywords: Live Streaming, think aloud protocol, introspection, cognitive psychology, phenomenology

Live Streaming is a multimedia technology which originates in the advances of the Web 2.0 (Li & Yin, 2007). It is constituted by user-created digital video streams that are transmitted via hosting platforms, such as prominently twitch.tv. Unlike Video-on-Demand formats, Live Streaming is submitted in real time (Karat et al., 2002). The immense requirement of bandwidth capacity did not allow for the reliable usage of the format for mass audiences before the second decade of the twenty-first century. As a result, the technology of Live Streaming has to be regarded as completely up-to-date in 2017. Its formal compounds consist of video and audio recordings of content that usually relates indirectly to the user – called "streamer" -, e.g. by showing their digital video gameplay, or directly containing them, especially using webcam recordings. The material is transmitted in a single frame and a single audio track to the audience, who can choose whether or not to interact with the streamer via written real time group chat (Barasch & Berger, 2014; Franquet i Calvet, Villa Montoya, & Bergillos García, 2013; Ko, Chang, & Chu, 2013).

Despite offering great variety of possible contents and contexts in initiating the usage of Live Streaming in psychology, its most pertinent format seems to be the submission of stationary single streamers that maintain a single content for a sufficiently long duration of time, especially video games. Video games are structurally characterized by their similarity to established paradigms of experimental psychology, e. g., problem solving tasks and dynamic decision making. To investigate dynamic decision making, empirical psychology employs situation simulation in virtual environments that are structurally equivalent to video games. E. g., Güss, Tuason and Orduña (2015) investigate the possibility to observe strategies, tactics and errors by the use of a digital microworld. They state that "complex and dynamic computersimulated problem scenarios" (p. 3) serve the investigation of the fields of complex problem solving and dynamic decision making. Another example is the study concerning the influence of personality on dynamic decision making by Nicholson and O'Hare (2014). Just as Güss et al. (2015), they found there research on the use of computer simulations that contain an interface which is conceptually analogous to video games. This diversity of research displays that computer simulations can be used for cognitive sciences in various ways.

However, Live Streaming offers a more elaborated opportunity to study the participants' behavior than the research based on computer simulations provides so far because the material obtained by Live Streaming enables a more detailed opportunity of observation and a fruitful analogy to the methodology of think aloud protocols since they observe individuals in their behavior, attending to singular tasks in a comparable manner (Funke & Spering, 2006). Yet, there are incremental discrepancies between both data sources, Live Streaming and think aloud protocols, that indicate an advantage of using data obtained through Live Streaming. In this paper, the innovative application of

Corresponding author: Alexander N. Wendt, Department of Psychology, Heidelberg University, Hauptstr 47-51, 69117 Heidelberg, Germany. e-mail: alexander@puwendt.de

Live Streaming as a data source in experimental psychology is proposed. This approach will be founded on the basis of classical epistemological and methodological debates.

Recent controversy in experimental psychology has indicated that the discipline's current methodological principles cannot guarantee further advances in understanding psychological behavior and experience (Funke, 2014; Jäkel & Schreiber, 2013; Ohlsson, 2012). Within experimental psychology, the currently predominant paradigm can be called cognitive psychology (Neisser, 2014). Its foundation may be criticized as a "Mechano-Representationalist Approach" (which consists of regarding cognition as information processing, for example, in computational modelling, and indirect realism), and has been questioned from external points-of-view, e. g., by phenomenology (Hutto, 2008). Following these critical approaches, the methodological exclusion of classical empirical concepts – such as introspection or think aloud protocols (Graumann, 1991; Fahrenberg, 2015) – that was recommended by Nisbett and Wilson (1977) may be scrutinized theoretically. In opposition to the standpoint of mere positivist methodology, this paper supports the re-integration of these classical methods on the basis of a theoretical discussion of the discipline's principles. In order to enrich epistemological debates within psychology, theoretical standpoints from a number of other fields are adopted, such as cultural-historical psychology and phenomenology. Crucially, the paper proposes that the methods' usability can be enhanced by combining them with recent technological development, namely Live Streaming.

The epistemological debate

The intuitive relevance of self-descriptive access to one's own or others' cognition has been palpable throughout the history of both naïve and empirical interest in behavior and experience. In the early conceptual stages of empirical psychology, these approaches have been most regularly used and initially appeared to be more reliable than any experimental methods (Fahrenberg, 2015; Galliker, 2016; Walach, 2013). Yet, over the course of paradigm shifts in the twentieth century within the discipline, the methods' pertinence was fundamentally questioned, to an equal degree in behaviorism and cognitive psychology. While the former denied the methods' objectives, the latter disclaimed their validity. In the second half of the twentieth century, neither introspection nor thinking aloud influenced the discipline's development to any noteworthy extent, as summarized by Lyons (1986). Yet the methods' apparent face validity was not obfuscated by this extensive critique; describing one's own experiences or regarding others' descriptions of their experiences remain to be the most intuitive form of psychology. Therefore, despite being harshly questioned, the core of these methods cannot lose its fundamental relevance – even if cognitive psychology might regard them only as empirical phenomena instead of reliable sources of data.

However, recent comments in psychology question the significance of the cognitive paradigm from standpoints external to empirical psychology (Hutto, 2008; Petitmengin & Bitbol, 2009; Zahavi & Gallagher, 2008) as well as internal to the cognitive sciences (Funke, 2014; Jäkel & Schreiber, 2013; Ohlsson, 2012). Subsequently, the critique of self-descriptive methods as developed by cognitive psychology is weakened, and the possibility for the review of previous controversies within experimental psychology arises. These circumstances favor not only methodological deliberation about the use of self-descriptive methods, but also discussion about psychological theory's epistemological foundations. Accordingly, a viewpoint beyond cognitive psychology can advocate the structurally scrutinized methods of self-description by considering alternative approaches to the objectives of psychology. Yet, in order to access this deliberation, a sufficient representation of the epistemological status quo is required.

The epistemological and methodological foundations of the debate about self-descriptive methods is characterized by three problems. First, the so-called subject-object problem. As put by Jaspers (1953, p. 25, translation by the author), "when we regard ourselves as the object, we become another one for ourselves while at the same time maintaining to be the thinking I itself". The problem's origin resides within the separation of subject and object made in indirect realism. Whilst the dualistic assumption of a separation between the perceiving subject and the perceived object is maintained, the self appears to be urged into a chimerical position of subject and object at the same time. Still, this statically egological conception of consciousness, as it has been established in Cartesian tradition, cannot claim an exclusive prevalence. Consider here e.g. Gurwitsch (1941), who demonstrates the existence of various non-egological conceptions of consciousness in the phenomenological province in Husserl or Sartre. The subject-object problem can only be seen as a disqualification of self-descriptive methods if the standpoint of indirect realism is radically maintained. Notwithstanding this epistemological reduction, the issue of the subject-object problem can be avoided if not resolved. The debate's second aspect can be entitled, the problem of methodology. It considers the question of whether self-description (introspection or thinking aloud) can be sufficiently justified as a source of empirical data in psychology. For behaviorism and the computational theory of mind in cognitive psychology, self-description has been judged to be an insufficient source of behavioral data (Aanstoos, 1987). Therefore, skepticism towards introspection and thinking aloud have been prevalent. Following Petitmengin and Bitpol (2009) and Jäkel and Schreiber (2013), the concerns of these dominant paradigms in empirical psychology can yet be answered. First, critique of self-description claims that the instruction to observe oneself contaminates the original behavior. However, this constraint must be preceded by the knowledge of

the behavior that in fact cannot be determined before observation. Therefore, this critique is based on a conception of sterile subjectivity that cannot be maintained in the light of an elaborate understanding of consciousness (Zahavi, 2005). Second, skeptical critique claims that the observed object of thought does not remain the same for the case of self-description. Nevertheless, this comment poses a naïve correspondence theory of truth that is ignorant of the subjective constitution of understanding. Third, the claim that the data of self-description cannot be reproduced can rather be applied to all sources of behavioral data instead of being biased against self-descriptive methods – a more neutral perspective, which has been applied recently (Open Science Collaboration, 2015). In this sense, the issue of reproducibility is not a mere issue for methods of self-description, and they do not appear any less applicable than other sources of data. Ultimately, the problem of methodology has been discussed as psychology seeks to position itself between two extreme attitudes, either proposing self-description's infallibility, as did classical philosophers (e. g., Descartes, Locke, Husserl), or else completely rejecting the method's applicability. Yet Petitmengin and Bitpol (2009) offer a compromise that abandons neither the methods nor the skepticism. They approach self-description carefully by regarding its epistemologically problematic nature while sustaining the valuable perspective of an immediate access to behavior and experience. In their case, they adopt a procedure of controlled continuous remembrance of the self-described episode to expose more psychological data to the empirical observation – an attempt that resembles the classical concepts of Brentano (1874).

The third problem regarding self-description's epistemological conditions can be called the problem of method. It regards the relation between the self-descriptive act (the subject's experience itself), the self-descriptive predication (the subject's verbalization) and the self-descriptive message (the verbalization's understanding). The two extreme positions towards self-description, its infallibility on the one side, and the rejection of its applicability on the other, can be characterized by these three elements. With regard to infallibility, the self-descriptive act evokes its adequate predication so that the message can be understood if accurate measures are applied. From this point of view, the interpretation of self-description becomes a hermeneutical matter. With regard to rejection, the self-descriptive act is rather unable to be predicated adequately (as Nisbett and Wilson, 1977 claim to expose), with the result that its message remains unrelated to the original act. From this standpoint, self-description is a futile endeavor. The compromise proposed by Petitmengin and Bitpol (2009) can be expressed by the relation of these three aspects, too: the self-descriptive predication has a contingent access to the act that can be activated by a procedure that resembles the phenomenological epoché, which is a continuous bracketing of experiences which is not essential to the act. However, these three approaches to the problem of method – infallibility, rejection and the (phenomenological) compromise – are equally reliant on a genetic subjectivity, which regards the act as the primary and unidirectional source of the self-description. On the contrary, a dialogical understanding of the situation of self-description, as it can be rendered on the basis of the cultural-historical psychology (e. g., Vygotsky, 1986), offers an alternative view. Whereas the previous approaches require one to comprehend the self-descriptive act as the spontaneous experience of an independent subject that unidirectionally evokes its predication, a dialogical understanding considers the possibility of a bidirectional influence of the self-descriptive predication and message. By this theoretical approach, higher cognition is exclusively available because it relates to the symbolic order that can be accessed only through dialogical exchange (Werani, 2011). In other words, from a cultural-historical standpoint, the self-descriptive message precedes the self-descriptive act, as it can be observed in infants' egocentric speech or clinical cases (Morin, 2009; Shengold, 1978). The decision to include this theoretical alternative, although not necessarily adopting it, enriches the problem's controversy by a significant aspect. The self-descriptive act no longer remains the posited internal cause of all self-description, but is understood equally as cause and effect of the experience which itself originates from the cultural situation of the dialogue. Allowing for this understanding means that the utility of self-description as a method in empirical psychology is not exclusively determined by access to a merely speculative instance of subjectivity. Understanding individuals' behavior and experience becomes a matter of understanding entirely observable processes. From the cultural-historical perspective, self-description advances from a questionable to a more promising concept (Alderson-Day & Fernyhough, 2015). Ultimately, the methods' viability is not as simple to judge as is normally assumed by cognitive psychology because it does not regard the dialogical approach's premises. Instead of neglecting the methods automatically within cognitive psychology, the discussion of its anthropological conditions becomes relevant.

A critical standpoint towards cognitive psychology's "Mechano-Representationalist Approach" and its two compounds – namely [1] cognition as information processing as exemplary in the computational theory of mind and [2] indirect realism – which yet remain predominant as the current epistemological paradigm in experimental psychology, allows us to advocate the methods of self-description, introspection and thinking aloud, for the three depicted problems, the subject-object problem, the problem of methodology and the problem of method. Clearly, the points made above do not entirely dismiss the critique – especially concerns of standardization, reliability and objectivity remain – but they can nullify the apparent banishment of self-description in experimental psychology since these remaining concerns are generally relevant for all kinds of data sources. As it were, a discursive field of an-

thropological debate in theoretical psychology can be exploited again that had already been fruitfully tilled in the discipline's history. On this basis the possibility of eliciting Live Streaming's viability as a method of empirical psychology comes into being.

What is Live Streaming?

In its current application, Live Streaming is not designed to be a paradigm of empirical psychology but to be a medium of communication and entertainment. The streamer decides to connect to a digital host for her content and provides the streamed material for as long as she plans. There are few editorial limitations. For example, in case of the hosting platform twitch.tv, the content is supposed to relate to video games, yet equally to allow for different content, like streamers, to present crafting activities, footage of conventions or art. Evaluation of its viability therefore requires an initial analysis of Live Streaming's general structure to enable a basic understanding of the medium's relevant details that can be availed as its empirical design features. In the following section, a description by form and by content will be given/provided.

In terms of media linguistics (Schmitz, 2015), Live Streaming is a transient, current, oral form of communication based on dynamic images. The requisite compounds are the video capture of the streamer by webcam, the video capture of the content by camera or computer screen capturing, the streamer's audio track captured by microphone, the content's audio track captured by microphone or direct computer audio capturing and (optionally) the written interaction with the audience. Live Streaming's most common function of communication is entertainment from the audience's point of view, while the streamer may be relating to the stream either professionally or for the purposes of leisure. Its mode of communication is characterized as multimodal, since it integrates different modes, such as audio, video and written text. The combination of different modes varies between the individual streams. Sometimes the webcam image has a prominent appearance, whereas in other cases the focus might lie merely on the content. The action can also continuously shift between sources.

An interesting further aspect of media linguistics is orality. As Live Streaming is a medium of the Internet, its language communication is occasionally self-referential. In linguistics, naïve direct oral communication which does not reflect upon its own status as language is called primary orality, as that which can be found in infants before they learn to write and read. Secondary orality, on the other hand, is aware of its own conditions, for example its grammar. In the case of Live Streaming, media linguistics observes tertiary orality, which by the means of new media starts to relieve the boundaries established in the secondary orality. As for Live Streaming, this can be stated by notingvarious characteristics of jargon in oral and written communication. Ultimately, the analysis of media linguistics provides a comparison with more established forms of communication, such as television. Television is a form of communication that is unidirectional, institutionalized, edited and directed towards an audience, while Live Streaming is bidirectional, decentralized, autonomous and contingently produced for an audience. These aspects not only differentiate the two media, but are also highly relevant for their ecological validity as potential paradigms in empirical psychology.

The analysis of media linguistics depicts Live Streaming as a form of communication with a consistent pattern of action. In its core characteristics, Live Streaming can be seen as a viable data source for field research because the general setup includes constant conditions which allow for comparisons both between subjects and within a single subject. Furthermore, the structural similarity to laboratory settings used by experimental psychology reinforces this viability and provides perspectives for the integration of the data. The stream meets the formal criteria for think aloud protocols (Funke & Spering, 2006), making the streamer the research's subject. Moreover, Live Streaming already implicitly contains constituents that are assessed as desirable for future research in experimental psychology's think aloud protocols, such as observation by webcam (Elling, Lentz, & De Jong, 2012). Therefore, in its form, Live Streaming can be altogether presumed to be a reliable and effective source of empirical data that is able to deal with the crucial concern of think aloud protocols' ecological validity while being intuitively accessible for comparisons with established self-descriptive laboratory research. Regarding its content, however, Live Streaming in theory is not restricted to a certain domain of situations for the streamer. The only limitations posed to the stream are bound to the technology's limits (yet these are de facto less restricted than any laboratory research) and the cultural dynamics that evoke the streamer's decisions (which yet are a priori not less creative than researchers' designs). Still, certain situations are more favorable for the interests of experimental psychology's research. For example, in so far as the comparison with psychological research into problem solving appears promising, Live Streams that present scenarios comparable to problem solving behavior or involve dynamic decision making are evidently preferable. In this case, the preference can be matched easily because the most established and common Live Streams contain video games – a content that is fairly similar to most problem solving paradigms (Monjelat, Zaballos, & Lacasa, 2012). As the example of this relationship between video games as the content of Live Streaming and problematic situations as the content of empirical paradigms in experimental psychology shows, Live Streaming's content contributes effectively to matters of psychology. Various and most typical cases of empirical research deal with games, be it board games such as chess (Aanstoos, 1983; de Groot, 1965; Huizinga, 1949; McGonigal, 2011) or video games (Adachi & Willoughby, 2013; Günzel, 2016; Sturz, Bodily, & Katz, 2009). By their

design, video games present highly standardized situations that can be independently repeated, therefore qualifying their contents as independent variables. Yet the variety of different video games at the same time creates an opportunity and poses a challenge to their scientific interpretation. The situations in which the streamer can engage are dependent on the genre, the singular video game and even the play mode she selects. Therefore, the scientific interpretation of these games requires a certain knowledge of their structure before being sufficient for comparison with established data sources in cognitive sciences.

To facilitate the psychological interpretation, cognitive sciences employ descriptions of video games drawing from media theory. For example, Günzel (2013; 2014; 2016) offers a terminology and ontology to classify video games in general and especially in the case of the genre of first-person shooter. He regards the material compounds of the spatial and temporal dimensions within the simulation as well as the subject's perception. By referring to media theory, psychology can decipher the structure of video games to enable a sufficient understanding of their setup In order to determine the elements that compare with established experimental paradigms.

However, crucial analogies between video games and empirical paradigms are already obvious at first sight. The difference between a digital simulation of chess and the board game itself, as it has been made a topic of psychology, is minimal; equally, there is a significant similarity between card games and digital simulation of card games, even when they are including additional graphic animations. Even more complex cases, such as strategic or action real time simulations, that integrate the dimension and experience of time into the game still have manifest consistency with empirical paradigms, which can be made visible when the games are described by their fundamental algorithmic compounds. Clearly, video games offer a major variety of scenarios that can be made the subject of discussion in the cognitive sciences. Psychological research has already utilized this feature of computer simulations (Dörner, Kreuzig, Reither, & Stäudel, 1983; Greiff, Holt, Wüstenberg, Goldhammer, & Funke, 2013).

Live Streaming's contribution to empirical psychology

To sum up the arguments gathered about Live Streaming's empirical potential so far, first, the epistemological context has been outlined. It has been shown that the rejection of self-descriptive methods relies on the presumptions of cognitive psychology, so that a phenomenological perspective on the subject-object problem, the problem of methodology and the problem of method could rule out the formal necessity of this rejection. Following the cultural-historical psychology, an alternative theoretical evaluation of self-description based on the primacy of social interaction can be employed that hosts the viability of thinking aloud and introspection which can be applied consecutively to the data source of Live Streaming. Second, the introduction of Live Streaming's formal compounds allowed the comparison with established forms of empirical observation and their objects: In the case of Live Streaming, the exemplary content of video games has been outlined. Now, in the third step, Live Streaming's possible contribution to psychological research shall be sketched out.

Overall, besides the formal viability of Live Streaming as a data source for empirical sciences, its content, through the example of video games (and beyond it), also bears sufficient similarity to prominent psychological matters. Moreover, the medium offers even more, yet contingent possibilities, such as overcoming the stationary data acquisition of laboratories by portable devices like smartphones that allow streaming in spatially dynamic contexts. Also, despite the ostensible advantage of greater ecological validity, Live Streams cover extensive circumferences of material: The example of streamer Octavian Morosan (https://www.twitch.tv/nl_kripp) demonstrates the coverage of five years of almost daily recordings by an average of more than six hours uninterrupted streaming schedule in a fairly standardized setup with sufficiently repeated content of video games – about 9000 hours of recordings. This amount of data is practically impossible to be generated in a laboratory. Developing a reliable way to analyze and interpret these data in the context of the above described debate about self-description allows for various uncharted empirical contents, such as long term developments in biographies or detailed observations of lifeworld.

Nevertheless, the decisive concern remains how Live Streaming provides a service for the purposes of current psychological study. Although apparently an applicable data source and qualitative observation method, it has to contribute to a critical content-related controversy in psychology in order to be a valuable addition to empirical methods. In regard to this matter, the above mentioned field of problem solving and dynamic decision-making research indicates a direction in which Live Streaming's material can be of use. Twentieth-century research about problem solving has been based on the approach provided by Newell und Simon (1972) that employs the computational theory of mind. Problems are conceptualized as the relation between initial state and goal state, inhibited by barriers. Yet, this approach has been criticized in its foundations in cognitive psychology (Aanstoos, 1983; Radley, 1991; Wertz, 1993) and its empirical applicability (Funke, 2014; Getzels, 1982; Ohlsson, 2012; Quesada, Kintsch, & Gomez, 2005). A fundamental revision of problem solving therefore bears a promising potential. However, this revision demands an essential expansion of the scope of previous reductionist theories. For Newell & Simon (1972), a problem is determined exclusively by its formal relations and it is thereby, for example, in no way different whether it is a problem for a human or a computer, whether it is solved in existential distress or as a matter of routine. The subjectivity involved in having a prob-

lem is not factored in by the computational theory of mind, the subject's perspective is merely embedded in the constellation of particular elements. A phenomenological approach to the notion of the problem, on the other side, would succeed to recover the totality that is present in the experience of having a problem. Phenomenology can discern between the formal relation of the problem material's elements and the subject's personal situation when it is facing the problem. Yet, these phenomenological thoughts methodologically are insufficiently founded when analyzed in the terms of contemporary psychology. They refer to occurrences that are hardly observed in the laboratory's sterile environment. To support this critical side of the controversy about problem solving and dynamic decision making, new means of empirical methodology are required. Live Streaming can propose a viable and promising candidate for this spot since it transcends the structural limitations of the empirical laboratory.

In this context, Koro-Ljungberg, Douglas, Therriault, Malcolm and McNeil (2013) ask whether think aloud protocols are viable in settings that were not generated by the investigator but are rather determined autonomously by the subject. Adopting a constructivist point of view, they opt for an expansion of traditional think aloud protocols by follow-up interviews to improve the observation of subjects' generation of knowledge whereas traditional think aloud protocols neglect the plasticity of actual behavior. This perspective equally applies to Live Streaming. The scope of observation can be expanded because the subjects act autonomously. Regarding this aspect, the apparent weakness of absent laboratory control can even be seen as an advantage. Another important perspective for Live Streaming is the above mentioned ecological validity. The empirical material's authenticity is dependent on the design's susceptibility for the subjects' voluntary behavior and the subjects' consciousness as well as their attitude. Self-descriptive methods are error-prone to these factors because the explicit awareness of being a test subject may (although by no means must) distort their genuine behavioral tendencies, for example by demand characteristics. Live Streaming bears a manifest, yet not unmitigated advantage over the laboratory designs since the streamer's role does not relate to being a test's subjects. However, the particular social constellation of exposing oneself to an internet audience still poses an influence on the behavioral tendencies. Nevertheless, this influence, rather than the laboratory's observation, is a natural one that can be compared to the role interests that are always present to human behavior by its social nature, as analyzed by sociology (Cooley, 1902; Lindesmith, 1983).

Equally in this social-psychological and sociological context, a further remark about the difference between traditional self-description and Live Streaming should be highlighted. As Goffman (1980) has pointed out, the individual social situation is characterized by a framework, independent of how many protagonists engage in it. In the case of laboratory research, this framework is dominated by the instructions and the artificial circumstances. In Live Streaming, however, the genuine complexity of this behavior can be observed because the circumstances are not manipulated and are therefore plenty. In other words, the behavior's variance is vastly increased. Certainly, this poses a challenge for quantitative attempts of interpretation, but still, Live Streaming's conceptual standardization allows for a basic access to approach the streamers' behavior scientifically within a most naturalistic setting.

To demonstrate the potential use of Live Streaming, the reference to an exemplary study in a similar domain can be illustrating. Rach and Kirsch (2016) investigated the possibility of modelling human problem solving with data from an online game. They implemented the well-established traveling salesperson problem (TSP) as the underlying structure to a casual online video game in order to obtain behavioral data about problem solving and dynamic decision making. In comparison with classical laboratory examinations, they expected benefits in ecological validity ("create an appealing game experience", p. 416) and the efficiency of data acquisition. Among their observations, they state certain aspects that indicate noteworthy behavioral accommodations, such as different attitudes towards the gameplay ("just curious" vs. "really ambitious"). These observations reflect a relevant situational difference between laboratorial and online settings.

However, Rach and Kirsch (2016) highlight some shortcomings of their design that can be compensated by adopting Live Streaming as an (additional) data source. In their discussion, they mention low level of controllability, such as "the environment and distraction level" (p. 425) or misunderstanding of the instructions, as a possible source of noise in the data. Moreover, they mention certain independent variables, e. g., the time invested into problem solving, which they were not able to interpret reliably, since they had no access to the participants' immediate behavior. All in all, the authors still recommend online games as an experimental method – a conclusion that coincides with the approach at hand. Beyond this general affirmation of the setting, Live Streaming would be able to compensate for the shortcomings of mere usage of online games while also inviting more detailed observations and interpretations. Yet, the level of detail applied to their simulation by Rach and Kirsch (2016) is very basic and structurally based on the TSP. To access the complexity of actual video games which opens the horizon of research towards dynamic decision-making, an elaborated approach to understand their structure is required. For instance, the terminology by Günzel mentioned above can serve this purpose in determining the problem space with the same precision that applies to simple problems as the TSP.

Another suitable example for the utility of Live Streaming research can be acquired in social sciences. Reeves, Greiffenhagen, and Laurier (2016) explore the possible insights from the observation of video games drawing on previous analysis of different gameplay set-

tings, such as playing in a group, as a couple or playing by oneself but "not alone" (p. 5) online. Their considerations are based on ethnomethodological thinking, an approach that originated in the development of phenomenological sociology and therefore resembles the endeavor at hand. The authors introduce different perspectives of analyzing gameplay, such as the consideration of the communication with other players, "muliactivity" (being "interwoven in other activities", p. 7) or the player's "placement" (p. 10).

In one case, the authors highlight that "the player in talking to the spectator formulates (for the spectator, but thereby also for the researchers) many aspects of the game that usually remain implicit, tacit, or unspoken" (p. 16), rendering a perspective that equally nourishes the psychological interest in Live Streaming. In their interpretations, the authors relate their observations to experiential features, such as "sequentiality" and "situadedness" (p. 21) or the "orderly character of everyday activities" (p. 23). By considering the resemblance to potential Live Streaming research, it can be outlined how the above elaborated concept may be of use. Just as in the case of Rach and Kirsch (2016), Reeves et al. (2016) state that – quoting Sacks – the application of video material would favor the depth of analysis by enabling to "start with things that are not currently imaginable, by showing that they happened" (p. 28). Live Streaming offers an ideal potential to meet this demand. Moreover the relationship between Live Streaming and self-descriptive methodology that has been advocated before, can expand the use of Live Streaming's material beyond the ethnomethodological approach of Reeves et al. (2016) who admit the methodological discrepancy between their work and cognitive sciences. In other words, the application of psychological research onto Live Streaming as a data source bears promising potential to integrate methods of social and cognitive sciences by surpassing the limitations of cognitive psychology.

In conclusion, using Live Streaming as an empirical data source not only circumvents the methodological limitations of traditional self-description for its ecological validity but also introduces greater behavioral variance to psychological observation. In order to obtain these potentials for experimental psychology, first, the theoretical discourse about self-descriptive methodology ought to be continued. Second, the new data source has to be explored by respective designs and established as a method by generating effective and reliable ways for its interpretation as it has been done for introspection and think aloud protocols over the course of psychology's history.

It has to be said that this investigation of the empirical potentials of Live Streaming is grounded on a theory-laden foundation. The approaches of phenomenology and the cultural-historical psychology as they have been advocated here, are not immune to critique. Consequently, the data source of Live Streaming might appear ideal to conceptual approaches such as ethnomethodology, as can be said with Bergmann (1991): "that advocates of ethnomethodology and the subsequent conversation analysis rely on audio-visual recordings of natural courses of interaction as primary data material" (p. 89, translation by the author), while it might at the same time encounter skepticism within cognitive psychology. However, this contradiction with regard to methodology is necessary to lay out when reviewing the theoretical controversy in experimental psychology and it indicates a vivid process of development in the sciences.

Acknowledgements: The author would like to give thanks to the two anonymous reviewers and the supervising editor Andreas Fischer for providing fruitful critique and substantial advices. Further thanks go to Jonathan Griffiths for carefully proofreading the manuscript.

Declaration of conflicting interests: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be constructed as a potential conflict of interest.

Handling editor: Andreas Fischer

Author contributions: The article's concept derives from the author's graduation thesis: "Die Tauglichkeit von Live-Streaming für die empirische Psychologie des Problemlösens" (2016), Psychology Department of the University of Heidelberg, supervising professors Joachim Funke and Momme von Sydow.

Supplementary material: No supplementary material available.

Citation: Wendt, A. N. (2017). The empirical potential of Live Streaming beyond cognitive psychology. *Journal of Dynamic Decision Making, 3*, 1. doi:10.11588/jddm.2017.1.33724

Received: 04 November 2016
Accepted: 26 February 2017
Published: 08 March 2017

References

Aanstoos, C. M. (1983). The think aloud method in descriptive research. *Journal of Phenomenological Psychology, 14*(2), 243-266.

Aanstoos, C. M. (1987). A critique of the computational model of thought: The contribution of Merleau-Ponty. *Journal of Phenomenological Psychology, 18*(2), 187-200.

Adachi, P. J., & Willoughby, T. (2013). More than just fun and games: The longitudinal relationships between strategic video games, self-reported problem solving skills, and academic

grades. *Journal of Youth and Adolescence, 42*(7), 1041-1052. doi:10.1007/s10964-013-9913-9

Alderson-Day, B. & Fernyhough, C. (2015). Inner speech: Development, cognitive functions, phenomenology, and neurobiology. *Psychological bulletin, 141*(5), 931-965. doi:10.1037/bul0000021

Barasch, A., & Berger, J. (2014). Broadcasting and narrowcasting: How audience size affects what people share. *Journal of Marketing Research, 51*(3), 286-299. doi:10.1509/jmr.13.0238

Bergmann, J. R. (1991). Deskriptive Praktiken als Gegenstand und Methode der Ethnomethodologie. In M. Herzog & C. F. Graumann (Eds.), *Sinn und Erfahrung. Phänomenologische Methoden in den Humanwissenschaften.* (pp. 86-102). Heidelberg, Germany: Asanger.

Brentano, F. (1874). *Psychologie vom empirischen Standpunkte.* Leipzig, Germany: Duncker & Humblot.

Cooley, C. H. (1902). *Human Nature and the Social Order.* New York, NY: Scribner's.

de Groot, A. D. (1965). *Thought and choice in chess.* The Hague, Netherlands: Mouton.

Dörner, D., Kreuzig, H.W., Reither, F. & Stäudel, T. (1983). *Lohhausen. Vom Umgang mit Unbestimmtheit und Komplexität.* Bern, Switzerland: Huber.

Elling, S., Lentz, L., & De Jong, M. (2012). Combining concurrent think-aloud protocols and eye-tracking observations: An analysis of verbalizations and silences. Professional Communication, 55(3), 206-220. doi:10.1109/TPC.2012.2206190

Fahrenberg, J. (2015). *Theoretische Psychologie – Eine Systematik der Kontroversen.* Lengerich, Germany: Pabst.

Franquet i Calvet, R., Villa Montoya, M. I., & Bergillos García, I. (2013). Public service broadcasting's participation in the reconfiguration of online news content. *Journal of Computer-Mediated Communication, 18*(3), 378-397. doi:10.1111/jcc4.12014

Funke, J. (2014). Problem solving: What are the important questions? In P. Bello, M. Guarini, M. McShane, & B. Scassellati (Eds.), *Proceedings of the 36th Annual Conference of the Cognitive Science Society* (pp. 493-498). Austin, TX: Cognitive Science Society.

Funke, J. & Spering, M. (2006). Methoden der Denk- und Problemlöseforschung. In J. Funke (Ed.), *Denken und Problemlösen (=Enzyklopädie der Psychologie, Themenbereich C: Theorie und Forschung, Serie II: Kognition, Band 8,* (pp. 675- 744). Göttingen, Germany: Hogrefe.

Galliker, M. (2016). *Ist die Psychologie eine Wissenschaft? Ihre Krisen und Kontroversen von den Anfängen bis zur Gegenwart.* Wiesbaden, Germany: Springer.

Getzels, J. W. (1982). The problem of the problem. In R. Hogarth (Ed.), *New directions for methodology of social and behavioral science: Question framing and response consistency.* ed. 11, (pp. 37-49). San Francisco, CA: Jossey-Bass.

Goffman, E. (1980). *Rahmen-Analyse. Ein Versuch über die Organisation von Alltagserfahrung.* Frankfurt am Main, Germany: Suhrkamp.

Graumann, C. F. (1991). Phänomenologie und Psychologie - ein problematisches Verhältnis. In M. Herzog & C. F. Graumann (Eds.), *Sinn und Erfahrung. Phänomenologische Methoden in den Humanwissenschaften.* (pp. 22-42). Heidelberg, Germany: Asanger.

Greiff, S., Holt, D. V., Wüstenberg, S., Goldhammer, F., & Funke, J. (2013). Computer-based assessment of complex problem solving: Concept, implementation, and application. *Educational Technology Research & Development, 61*, 407-421. doi:10.1007/s11423-013-9301-x

Günzel, S. (2013). Vom Sehen des Sehens zum Sehen des sich selbst Sehens. Das Computerspielbild der ersten Person. In A. Böhler, C. Herzog, & A. Pechriggel (Eds.), *Korporale Performanz. Zur bedeutungsgenerierenden Dimension des Leibes.* (pp. 123-154). Bielefeld, Germany: Transcript.

Günzel, S. (2014). Eine Frage der Perspektive, oder: Was weiß der Film über die Räume des Computerspiels? In J. Pause, D. Müller, & I. Gradinari (Eds.) *Wissensraum Film. Trierer Beiträge zu den Historischen Kulturwissenschaften*, Bd. 13 (pp. 169-200) Wiesbaden, Germany: Reichert.

Günzel, S. (2016). Zur ästhetischen Form des Computerspielbildes. In J. Sorg, & J. Venus (Eds.), *Erzählformen im Computerspiel. Zur Medienmorphologie digitaler Spiele.* Bielefeld, Germany: Transcript.

Gurwitsch, A. (1941). A non-ecological conception of consciousness. *Philosophy and Phenomenological Research, 1*(3), 325-338. doi:10.2307/2102762

Güss, C. D., Tuason, M. T., & Orduña, L. V. (2015). Strategies, tactics, and errors in dynamic decision making in an Asian sample. *Journal of Dynamic Decision Making, 1*,1. doi:10.11588/jddm.2015.1.13131

Huizinga, J. (1949). *Homo Ludens. A study of the play-element in culture.* London, UK: Routledge & Kegan Paul.

Hutto, D. D. (2008). Articulating and understanding the phenomenological manifesto. *Abstracta, 4*(3), 10-19.

Jäkel, F. & Schreiber, C. (2013). Introspection in problem solving. *The Journal of Problem Solving, 6*(1), 20-33. doi:10.7771/1932-6246.1131

Jaspers, K. (1953). *Einführung in die Philosophie.* München, Germany: Piper.

Karat, C. M., Karat, J., Vergo, J., Pinhanez, C., Riecken, D., & Cofino, T. (2002). That's entertainment! Designing streaming, multimedia web experiences. *International Journal of Human-Computer Interaction, 14*(3-4), 369-384. doi:10.1080/10447318.2002.9669125

Ko, H. T., Chang, C., & Chu, N. S. (2013). An empirical investigation of the consumer demand for digital television application services. *Behaviour & Information Technology, 32*(4), 397-409. doi:10.1080/0144929X.2011.608810

Koro-Ljungberg, M., Douglas, E. P., Therriault, D., Malcolm, Z., & McNeill, N. (2013). Reconceptualizing and decentering think-aloud methodology in qualitative research. *Qualitative Research, 13*(6), 735-753. doi:10.1177/1468794112455040

Li, B. & Yin, H. (2007). Peer-to-peer live video streaming on the internet: issues, existing approaches, and challenges [Peer-to-Peer Multimedia Streaming]. *Communications magazine, 45*(6), 94-99. doi:10.1109/MCOM.2007.374425

Lindesmith, A. R. & Strauss, A. L. (1983). *Symbolische Bedingungen der Sozialisation. Eine Sozialpsychologie.* Frankfurt am Main, Germany: Ullstein.

Lyons, W. E. (1986). *The disappearance of introspection.* Cambridge, UK: MIT Press.

McGonigal, J. (2011). *Reality is broken: Why games make us better and how they can change the world.* London, UK: J. Cape.

Monjelat, N., Zaballos, L. M., & Lacasa, P. (2012). Procesos de resolución de problemas y videojuegos: el caso de Sim City Creator. *Electronic Journal of Research in Educational Psychology, 10*(28), 1493-1522.

Morin, A. (2009). Self-awareness deficits following loss of inner speech: Dr. Jill Bolte Taylor's case study. *Consciousness and Cognition, 18*(2), 524-529. doi:10.1016/j.concog.2008.09.008

Neisser, U. (2014). *Cognitive psychology: Classic edition.* New York, NY: Psychology Press.

Newell, A., & Simon, H. A. (1972). *Human problem solving.* Englewood Cliffs, NJ: Prentice-Hall.

Nicholson, B., & O'Hare, D. (2014). The effects of individual differences, prior experience and cognitive load on the transfer of dynamic decision-making performance. *Ergonomics, 57*(9), 1353-1365. doi:10.1080/00140139.2014.933884

Nisbett, R. E. & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological review, 84*(3), 231-259. doi:10.1037/0033-295X.84.3.231

Ohlsson, S. (2012). The problems with problem solving: Reflections on the rise, current status, and possible future of a cognitive research paradigm. *The Journal of Problem Solving, 5*(1), 101-128. doi:10.7771/1932-6246.1144

Open Science Collaboration (2015). Estimating the reproducibility of psychological science. *Science, 349*(6251), aac4716. doi:10.1126/science.aac4716

Petitmengin, C. & Bitbol, M. (2009). Listening from within. *Journal of Consciousness Studies, 16*(10-12), 363-404.

Quesada, J., Kintsch, W., & Gomez, E. (2005). Complex problem-solving: a field in search of a definition? *Theoretical Issues in Ergonomics Science. 6*(1), 5-33. doi:10.1080/14639220512331311553

Rach, T. & Kirsch, A. (2016). Modelling human problem solving with data from an online game. *Cognitive processing, 17*(4), 415-428. doi:10.1007/s10339-016-0767-4

Radley, A. (1991). Solving a problem together: A study of thinking in small groups. *Journal of Phenomenological Psychology, 22*(1), 39-59.

Reeves, S., Greiffenhagen, C., & Laurier, E. (2016). Video gaming as practical accomplishment: Ethnomethodology, conversation analysis, and play. *Topics in Cognitive Science,* 1-35. doi:10.1111/tops.12234

Schmitz, U. (2015). *Einführung in die Medienlinguistik.* Darmstadt, Germany: Wissenschaftliche Buchgesellschaft.

Shengold, L. (1978). Kaspar Hauser and soul murder: A study of deprivation. *International Review of Psycho-Analysis, 5,* 457-476.

Sturz, B. R., Bodily, K. D., & Katz, J. S. (2009). Dissociation of past and present experience in problem solving using a virtual environment. *CyberPsychology & Behavior, 12*(1), 15-19. doi:10.1089/cpb.2008.0147

Vygotsky, L. S. (1986). *Denken und Sprechen.* Frankfurt am Main, Germany: Fischer.

Walach, H. (2013). *Psychologie. Wissenschaftstheorie, philosophische Grundlagen und Geschichte.* Stuttgart, Germany: Kohlhammer.

Werani, A. (2011). *Inneres Sprechen: Ergebnisse einer Indiziensuche.* Berlin, Germany: Lehmanns.

Wertz, F. J. (1993). Cognitive psychology: A phenomenological critique. *Journal of Theoretical and Philosophical Psychology, 13*(1), 2-24. doi:10.1037/h0091109

Zahavi, D. (2005). *Subjectivity and selfhood. Investigating the First-Person Perspective.* Massachusetts, MA: Bradford.

Zahavi, D. & Gallagher, S. (2008). Reply: A phenomenology with legs and brains. *Abstracta, 4*(3), 86-107.